## IV Year WSN Important Questions
## SHORT QUESTIONS

1. Why mutihop wireless communication is required for WSN?
2. What is data centric network? Explain with suitable diagram.
3. Differentiate active and passive sensors.
4. State the mathematical model of energy consumption during transmission and reception of a transceiver.
5. List the factors that are required for PHY design of WSN.
6. Briefly explain IEEE 802.15.4 MAC Layer.
7. State the fundamental task of address management in WSN.
8. Can ASIC be used in Wireless Sensor Networks?
9. Compare MANET and WSN.
10. Briefly explain about SMACS.
11. Give the list of the appropriate transceivers for WSNs.
12. Briefly explain hierarchical routing protocols.
13. Why does TCP not work well in ad hoc network?
14. State few characteristic requirements of WSNs.
15. What is the concept of Flooding mechanism?
16. Write the Future directions of WSN.
17. Write about optimization goal and Figure of Merit
18. What are the applications needed in a MANET?
19. Write the applications of wireless sensor networks.
20. Describe the Berkeley Motes.

## LONG QUESTIONS

1. Write notes on
   (i) Dynamic Energy and power management
   (ii) TinyOS and nesC
   (iii) Programming Models in WSN
2. (i)Explain the design approaches and performance of S-MAC protocol.
   (ii)Explain the concept of TRAMA protocol.
3. (i) Discuss the characteristic requirements of WSN.
   (ii)Explain the innovative mechanisms to realize the characteristic requirements of WSN.
4. (i) Briefly discuss about the applications of WSNs.
   (ii) Discuss in detail the Transceiver characteristics and structure.
5. (i) Explain about various clustering mechanisms in WSN. Also detail about the sensor tasking and Control.

(ii) What are differences between Zigbee and Bluetooth Technology?

6. (i) Discuss in detail about design principles of WSN.
   (ii) Elaborate on energy scavenging techniques for sensor nodes.
7. (i) What is WSN Tunneling? Explain with example.
   (ii) Explain the concept of gateway with different scenarios in WSN.
8. (i) Discuss in detail about the energy consumption of Sensor Nodes.
   (ii)Write about the enabling technologies for wireless sensor networks.
9. (i) Explain in detail personal area networks (PANs).
   (ii) Write about the topologies of MANETs and WANETs.
10. (i) Discuss about hierarchical routing protocols.
    (ii)Discuss about efficient flooding routing protocols.
11. Briefly specify IEEE 802.15.4 MAC protocol and explain whether the MAC protocols of 802.11 & Bluetooth be used for WSN. Justify. (6)
    (ii) Illustrate the basics of contention-based protocol for WSN.
12. (i) Write short note on State-centric programming.
    (ii)Write short note on Wireless fidelity systems.
13. (i) Explain various challenges and of potential applications of wireless sensor Networks.
    (ii) Define the types of Sensors.
14. (i) What are different issues in designing network protocol?
    (ii) What is communication protocol stack?

**MATRUSRI ENGINEERING COLLEGE**

**SAIDABAD, HYDERABAD – 500 059**

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

Academic year: 2018-19

| | | | | | |
|---|---|---|---|---|---|
| Faculty Name | : | **Dr.Nukala Srinivasa Rao** | **Dept** | **:** | **ECE** |
| Subject Name | : | **Wireless Sensors & Networks** | **Code** | **:** | **EC474** |
| Year | : | **IV ELECTIVE IV** | Semester | : | II |
| Degree & Branch | : | BE&ECE | Academic Year | : | 2017-18 & 2018-19 |
| | | L=3; T=1; Sessional=25; External=75 | Credits =3 | | |

**LIST OF CONTENTS:**

| | | |
|---|---|---|
| 17. | Question bank (Objective & Essay type unit wise) | |
| 18. | Assignment questions | |
| 19. | Tutorial problems | |
| 20. | Discussion topics, if any | |
| 21. | References, Journals, Websites and E-links, if any | |
| 22. | Quality Measurement Sheets<br>a. Course end Survey<br>b. Teaching Evaluation | |
| 23. | Student List | |
| 24. | Group – Wise students list for discussion topics | |
| 25. | Any other relevant material like web resources etc. | |

# COURSE FILE

**ACADEMIC YEAR 2017-2018**
**II Semester**

# EC474– Wireless Sensors &Networks

By

**Dr.Nukala Srinivasa Rao**
**Professor of ECE Dept.**

**2019**

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**MATRUSRI ENGINEERING COLLEGE**
**(Sponsored by Matrusri Education Society, Estd.1980)**
(Approved by AICTE & Affiliated to Osmania University)
#16-1-486, Saidabad, Hyderabad – 500 059, Ph: 040-24072764
**Email: matrusri.principal@gmail.com, www.matrusri.edu.in**

## 2. SYLLABUS COPY PRESCRIBED BY THE UNIVERSITY

**Academic Year 2017-2018 II Semester**

# EC474- Wireless Sensors & Networks

**UNIT I : OVERVIEW OF WIRELESS SENSOR NETWORKS:** Key definitions of sensor networks, Advantages of sensor Networks, Unique constraints an challenges, Driving Applications, Enabling Technologies for Wireless Sensor Networks. **ARCHITECTURES**: Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

**UNIT II : NETWORKING Technologies:** Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, WANETs.

**UNIT-III : MAC Protocols for Wireless Sensor Networks:** Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention – Based Protocols, Contention – Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

**UNIT-IV : ROUTING PROTOCOLS**: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table – Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.

**UNIT-V : TRANSPORT LAYER AND SECURITY PROTOCOLS:** Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

**UNIT- VI : SECURITY IN WSNs:** Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks. SENSOR NETWORK PLATFORMS AND TOOLS: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node- level software platforms, Node-level Simulators, State-centric programming.

**APPLICATIONS of WSN:** S Ultra wide band radio communication, Wireless fidelity systems. Future directions, Home automation, smart metering Applications.

**TEXT BOOKS**

- Ad Hoc Wireless Networks: Architectures and Protocols – C. Siva Ram Murthy and B.S.Manoj, 2004, PHI
- Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – Jagannathan Sarangapani, CRC Press
- Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 2005.

**REFERENCES**

- Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
- Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
- Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh ,1 ed. Pearson Education.
- Wireless Sensor Networks – C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.
- Wireless Sensor Networks – S Anandamurugan , Lakshmi Publications.


## 3. VISION OF THE DEPARTMENT

To become a reputed centre of learning in Electronics and Communication and transform the students into accomplished professionals.

## 4. MISSION OF THE DEPARTMENT

**M1:** To provide the learning ambience to nurture the young minds with theoretical and practical knowledge to produce employable and competent engineers.

**M2:** To provide a strong foundation in fundamentals of electronics and communication engineering to make students explore advances in research for higher learning.

**M3:** To inculcate awareness for societal needs, continuous learning and professional practices.

**M4:** To imbibe team spirit and leadership qualities among students.

## 1. Program Educational Objectives (PEO):

*After graduation, the students will have the ability to:*

**PEO1:** Acquire, comprehend, apply, basic Sciences & Engineering knowledge to analyze, evaluate, design and implement solutions in Electronics and communication Engineering.

**PEO2:** Engage in higher learning, for contributing to technological Innovations, and adapt to changes in technology by continuous Learning.

**PEO3:** Work with respect for societal values and concern for environment in implementing engineering solutions.

**PEO4:** Perform with professional ethics as an individual or as a team player to realize the goals of the organization/society.

## Program Specific Outcomes (PSOs):

*ECE graduates will be able to:*

**PSO1:** Carry out Electronic system design and contribute towards Electronic Hardware/Software design solutions required for Industries.

**PSO2:** Analyze societal requirements for providing/taking up higher studies and research in allied areas.

**PSO3:** Use acquired technical soft skills to qualify for working in Public, Private and IT sector.

## Program Outcomes (POs):

*Upon the completion of programme, the student will be able to*

**PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/Development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct Investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of,and need for sustainable development.

**PO8: Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-Long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## 2. COURSE OBJECTIVES & OUTCOMES

**COURSE OBJECTIVES:**

The objective of this course is to make the students

1. To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
2. Understand the medium access control protocols and address physical layer issues
3. Learn key routing protocols for sensor networks and main design issues
4. Learn transport layer protocols for sensor networks, and design requirements
5. Understand the Sensor management ,sensor network middleware, operating systems.

**COURSE OUTCOMES:**

After completing Wireless Sensor Networks, students will be equipped with a basic understanding of the following:

| Course Outcome | Explanation<br>Students are able to |
|---|---|
| **EC474.**1 | • fault-tolerance and security -proposed mechanisms for the deployment and configuration of sensors &wireless communication standards |
| **EC474.**2 | • energy-efficient data gathering &handling challenging wireless link conditions &data-centric querying |
| **EC474.3** | • routing and storage & maximizing network lifetime and capacity |
| | • |

| | |
|---|---|
| **EC474.**4 | • collaborative signal processing & reliability |
| **EC474.**5 | |

## 3. Brief Notes on the importance of the Course

In the past decades, Wireless Sensor Network (WSN) has become a wide area of research. In WSN, numerous sensor nodes are randomly setup with different energy level. Energy acts as power source and is available to each sensor node in limited quantity. The limiting factor is that sensor nodes are energy constrained and recharging or replacing battery is costly and complex process. This paper explores the different energy consumption factors which effect the lifetime and performance of the WSN's. The main factors which effect the energy consumption in WSN's are scalability, load balancing, reliability, communication, collision, over-hearing, ideal listing and latency. Researchers have proved that the node near to sink node discharge very fastly. Apart from these, most of the energy is consumed during the transfer of data from sender to receiver. In this paper effort is made to analyze the effect of different factors on energy consumption in WSN's. Wireless Sensor Networks(WSN's) is a network consisting of numerous sensor nodes. A sensor node(SN) is a multifunctional, low-power and low-cost tiny size device. SNs are randomly deployed over a zone to measure various phenomena like humidity, moisture, vibrations and many more. By enhancing the capabilities of sensor nodes, realization of WSNs based on the collaborative effort of sensor nodes is easy[1]. SN has four basic components Sensing unit, Processing unit, Transceiver unit and Power unit are shown in Figure 1.SNsare broadlyclassified as normal nodes,advanced nodes and super nodes. Apparently, the normal nodes have the least energy level, the advanced nodes have more energy than the normal nodes and the super nodes have the highest level of energy[2].The major advantages of SNs incomparision to the normal nodes are their ability to operate in harsh environment in which contemporary monitoring is risky and sometime not feasible.SN's are established randomly in field of interest by uncontrolled means like dropped by a helicopter etc. The general architecture of WSN's is shown in Figure 2. SNs collect data and transmit to the base station or sink node[3]. Therefore data collection can be single hop or multi-hop.Sink nodeis an intermediate node which receives the data from the sensor field and transmits over the internet. In WSN's, SNs are randomly setup in a geographical region. This region is divided into sub-regions called clusters. In each cluster, one of the nodeis selected as cluster head (CH) and the remaining nodes are cluster members[4]. CH is chosen on the basis of weighted probability. The node having highest weight probability has more chance to become a CH. Weight probability is the ratio of residual energy of node and average energy of wireless sensor network.

## 4. Prerequisites

**Knowledge about Computer architecture and networks ad topology**

## 5. INSTRUCTIONAL LEARNING OUTCOMES

Learning outcomes are the key abilities and knowledge that will be assessed

## 6. COURSE MAPPING WITH POS

**Course Mapping wit POs and PSOs.**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course** | 3 | 3 | 2 | 3 | 2 | 2 | - | 3 | - | - | - | - | 2 | 2 | 3 |

**CO mapping with POs and PSOs**

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EC474.** 1 | 3 | 2 | | | | | | | | | | | 2 | 2 | |
| **EC474.** 2 | 3 | 3 | 2 | | | | | | | | | | 2 | 2 | |
| **EC474. 3** | | | 2 | 3 | 2 | 2 | | 3 | | | | | 2 | 2 | |
| **EC474.** 4 | | | 3 | 2 | | | | | | | | | 3 | 3 | 3 |
| **EC474.** 5 | 3 | | | | | | | | | | | | 2 | 2 | |
| **Attain ment** | 3 | 2.5 | 2.3 | 2.5 | 2 | 2 | | 3 | | | | | 2.2 | 2.2 | 3 |

## 7. CLASS TIME TABLE

| TIME / DAY | 9.40am to 10.30am | 10:30 am to 11:20 am | 11:20 am to 12:10 pm | 12:10 pm to 1:00 pm | 1:00 pm to 1:40 pm | 1:40 pm to 2:30 pm | 2:30 pm to 3:20 pm | 3:20 pm to 4:10 pm |
|---|---|---|---|---|---|---|---|---|
| **MON** | **WSN** | | | | **U N C H** | | | |
| **TUE** | | | **DC** | **DC** | | | **WSN** | **WSN** |
| **WED** | | **WSN** | | | | | | **TUTORIA L** |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## 8. INDIVIDUAL TIME TABLE

| TIME / DAY | 9.40am to 10.30am | 10:30 am to 11:20 am | 11:20 am to 12:10 pm | 12:10 pm to 1:00 pm | 1:00 pm to 1:40 pm | 1:40 pm to 2:30 pm | 2:30 pm to 3:20 pm | 3:20 pm to 4:10 pm |
|---|---|---|---|---|---|---|---|---|
| MON | WSN | | | | LUNCH | | | |
| TUE | | | | | | WSN | WSN | |
| WED | | WSN | | | | | | |
| THU | | | | | | | | |
| FRI | | | | | | | | |

## 9. LECTURE SCHEDULE WITH METHODOLOGY BEING USED/ADOPTED

| S.No | Topic(s) | No. of Periods | Remarks |
|---|---|---|---|
| **UNIT – I (** | | | |
| 1. | Introduction | 1 | .PPT/LCD/BB |
| 2. | What IS WSN? Need for it | 1 | .PPT/LCD/BB |
| 3. | Characteristics requirements | 1 | .PPT/LCD/BB |
| 4. | Sensors and networks | 2 | .PPT/LCD/BB |
| 5. | Mobile networks and WSN | 1 | .PPT/LCD/BB |
| 6. | Enabling technologies for WSN | 1 | .PPT/LCD/BB |
| 7. | Tutorials | 2 | .PPT/LCD/BB |
| 8. | Assignment | 1 | .PPT/LCD/BB |
| 9. | Revision of above topics | 1 | .PPT/LCD/BB |
| **Total No. of Periods: 11** | | | |
| **S.No** | **Topic(s)** | **No.of Periods** | **Remarks** |
| **UNIT – II (Antenna Analysis)** | | | |
| 1. | Architectures Sensor node review/controller./memory/communication Device/ Power supply | 1 | .PPT/LCD/BB |
| 2. | Energy Consumption of Sensor nodes | 1 | .PPT/LCD/BB |
| 3. | Operation states with different power Consumption/ microcontrollers/memory/radio transreceivers/ | 1 | .PPT/LCD/BB |
| 4. | | 1 | |
| 5. | | 2 | |
| 6. | | 2 | |
| 7. | | 1 | |
| 8. | | 1 | |
| **Total No. of Periods: 10** | | | |
| **UNIT – III (Types of Antenna)** | | | |
| **S.No** | **Topic(s)** | **No. of Periods** | **Remarks** |
| 1. | | 1 | |
| 2. | | 1 | |
| 3. | | 1 | |

| | | | |
|---|---|---|---|
| **4.** | | **1** | |
| **5.** | | **1** | |
| **6.** | | **1** | |
| **7.** | | **1** | |
| **8.** | | **1** | |
| **9.** | | **1** | |
| **10.** | | **1** | |
| **Total No. of Periods: 10** | | | |
| **S.No** | **Topic(s)** | **No. of Periods** | **Remarks** |
| **UNIT – IV ( )** | | | |
| **1.** | | **1** | |
| **2.** | | **1** | |
| **3.** | | **1** | |
| **4.** | | **1** | |
| **5.** | | **1** | |
| **6.** | | **1** | |
| **7.** | | **1** | |
| **8.** | | **1** | |
| **9.** | | **1** | |
| **10.** | | **1** | |
| **11.** | | **1** | |
| **Total No. of Periods: 10** | | | |
| **S.No** | **Topic(s)** | **No. of Periods** | **Remarks** |
| **UNIT – V ( )** | | | |
| **1.** | | **1** | |
| **2.** | | **1** | |
| **3.** | | **1** | |
| **4.** | | **1** | |
| **5.** | | **1** | |
| **6.** | | **1** | |
| **7.** | | **2** | |
| **8.** | | **1** | |
| **Total No. of Periods: 9** | | | |

**TOTAL: ___50_____ PERIODS**

## 10. DETAILED NOTES

**Unit – 1**

# 1. Fundamental Concept

## 1.1 Introduction:

## 17. QUESTION BANK