ECX5121	Wireless Sensor Networks	L-T-P: 3-0-0; Cr: 03

Prerequisite: Communication Engineering, Computer Communication Network

Course Objective: Wide range of applications such as disaster management, military and security have fueled the interest in sensor networks during the past few years. Sensors are typically capable of wireless communication and are significantly constrained in the amount of available resources such as energy, storage and computation. Such constraints make the design and operation of sensor networks considerably different from contemporary wireless networks, and necessitate the development of resource conscious protocols and management techniques. This course provides a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks. Covered topics include network architectures, node discovery and localization, deployment strategies, node coverage, routing protocols, medium access arbitration, fault-tolerance, and network security.

COURSE CONTENT:

Unit-I: Introduction Examples of available sensor nodes; Sample sensor networks applications; Design challenges

Unit-II: Design Model Contemporary network architectures; Operational and computational models; Performance metrics; Software and hardware setups.

Unit-III: Network Bootstrapping Sensor deployment mechanisms; Issues of coverage; Node discovery protocols; Localization schemes; Network clustering

Unit-IV: Data dissemination and routing Query models; In-network data aggregation; Robust route setup; Coping with energy constraints

Unit-V: Physical and Link layers Radio energy consumption model; Power management; Medium access arbitration; Optimization mechanisms

Unit-VI: Dependability Issues Security challenges; Threat and attack models; Quality of service provisioning; Clock synchronization; Supporting fault tolerant operation

Course Outcomes: After successful completion of the course, students would be able to -

Students would be able to –

CO1 Architect sensor networks for various application setups.
CO2 Explore the design space and conduct trade-off analysis between performance and resources.
CO3 Assess coverage and conduct node deployment planning.
CO4 Devise appropriate data dissemination protocols and model links cost.
CO5 Determine suitable medium access protocols and radio hardware.
CO6 Design understanding prototype sensor networks using commercial components.

CO7 Design understanding provision quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.

CO8 Evaluate the performance of sensor networks and identify bottlenecks.

Text Books:

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, Wiley, 2005.

2. Wireless Sensor Networks, Cauligi S. Raghavendra, Krishna Sivalingam, and Taieb M. Znati, Springer, 2005.

ECx5122	Optoelectronics	L-T-P: 3-0-0; Cr: 03

Pre-requisite: Communication Engineering (EC4502), Analog Electronics.

Objectives: Learning the basic concepts of Optoelectronics and related devices/systems.

COURSE CONTENTS:

Unit-I: Overview of Optical fibres and waveguides: Basics of Optical Fibers (Single/Multi-mode, Step/Graded index), Normalized Frequency, Description of Modes, Distortions in Optical Fibers (Attenuation & Dispersion), Dispersion Shifted and Dispersion flattened fibers, Fiber birefringence, Concepts of solitons, Loss mechanism in Fiber (Losses - Insertion, Return, Intrinsic, Reflection, etc.), Dielectric Slab Waveguide (Modes in symmetric slab waveguide, Mode condition, TE & TM polarization, Higher Order modes, Mode Pattern, Description of Fiber cable and Fiber splicing. **(7 L)**

Unit-II: Optical Source 1 – LASER: Major requirements for an optical sources, Direct & Indirect bandgap semiconductors, Description of different efficiencies in optical sources, Introduction to LASERs, Population Inversion, Einstein Coefficients for Absorption and Emission, Laser Oscillation & its threshold condition, Semiconductor materials for optical sources, Semiconductor Injection Laser: Structures & characteristics, Modulation of Laser diodes, Impact of temperature, Noise in Laser (Modal noise, Mode-partition noise, and Reflection noise), Non-semiconductor Lasers (Nd-YAG Laser & Glass fiber Lasers). **(7 L)**

Unit-III: Optical Source 2 – Light Emitting Diode: Introduction to Light Emitting Diodes, LED Power and Efficiencies, Description of different efficiencies in optical sources, Double hetero-junction LED, LED structures: Planar LED, Dome LED, Burrus-type LED, Surface emitting LED, Edge emitting LED, Super-luminescent LED, Quantum dot LEDs; LED characteristics (optical output power and spectrum, modulation capability, Transient Response, Power-Bandwidth product). **(6 L)**

Unit-IV: Optical Detectors: Major requirements for optical detectors, Device types, Principle of Optical detection, Quantum efficiency & Responsivity, Absorption, Long-wavelength cutoff, Photo detectors without internal gain (p-n photodiode, PIN photodiode), Photo detectors with internal gain