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Course Description and Objective:

The course addresses the fundamentals of wireless communications and provides an overview of existing and emerging wireless communications networks. It covers radio propagation and fading models, fundamentals of cellular communications, multiple access technologies, and various wireless networks, including past and future generation networks. Simulation of wireless systems under different channel environments will be integral part of this course.

The objective of the course is to introduce the students to the fundamentals of wireless communications and the evolution of wireless networks from the first generation to LTE and LTE advanced.

Course Outcome:

The student will be able to:

- ✓ Understand the basic concept of wireless system design and get familiar with various wireless networks
- ✓ Understand the new trends in mobile/wireless communications networks.
- ✓ Understand multiple radio access techniques.
- ✓ Analyze various routing algorithms used in mobile/wireless networks.
- ✓ Identify the issues in transport and application layers.

Skills:

- ✓ Identify and simulate the medium access control mechanisms suitable for given applications.
- ✓ Develop ad-hoc network applications using appropriate algorithms/protocols.
- ✓ Identify the impact of improvements made to TCP in mobile/wireless networks.
- ✓ Identify the need of mobile IP and simulating mobile IP network.

Activities

- ✓ Choose medium access control mechanism for a given application.
- ✓ Distinguish among various wireless networks.
- ✓ Simulate the calling mechanism used in GSM.
- ✓ Design and simulate a simple wireless network.
- ✓ Analyze the customization of TCP in wireless network.

Unit-I

Overview of Wireless Communications and Systems: Review of digital communications, Cellular systems from 1G to 3G Wireless 4G systems, Radio propagation and propagation path-loss model, Free-space attenuation, Multipath channel characteristics, Signal fading statistics, Path-loss models.

Unit-II

Fundamentals of Cellular Communications: Hexagonal cell geometry, Co-channel interference, Cellular system design, Sectoring using directional antennas.

Unit-III

Multiple Access Techniques: Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA), Orthogonal frequency division multiplexing (OFDM), Multicarrier CDMA (MC-CDMA), Random access methods.

Unit-IV

Wide-area Wireless Networks (WANs): GSM – IS-136 IS-95, UMTS Cdma2000, Long Term Evolution Technologies (LTE), and OFDM MIMO channels, Space Time Codes LTE Advanced.

Unit-V

Other Wireless systems: IEEE 802.11, WLAN (WiFi) WiMAX

Textbook:

1. Mischa Schwartz, “Mobile Wireless Communications,” Cambridge University Press, Paperback, 2013, ISBN: 9781107412712.

References:

1. Ian F. Akyildiz, David M. GutierrezEstevez, Elias Chavarria Reyes, “The evolution to 4G cellular systems: LTE-Advanced,” Elsevier-Physical Communication, 2010.
2. Vijay K. Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, 2007, ISBN 978-0-12-373580-5.
3. Jochen Schiller, Mobile Communications, Addison-Wesley, Second edition, 2008.