Title of Course: RF and Antenna Engineering

Code and Credit Structure: CT425  3-0-0-3

Course Placement: Technical Elective for BTech (ICT & CS) – 7th Semester

Instructor: Prof. Sanjeev Gupta

Aims and Objectives:

The transmission of information data through Radio Frequency (RF) energy has become the most efficient way of communication from one point to another in present scenario. For many years, RF technology has been used in defense and satellite applications, atmospheric research, radio spectroscopy, domestic microwave ovens and many other industrial applications. Other major application areas of RF Engineering include Mobile, Radar, remote communication and Astronomy. Modern technologies like Wi-Fi, WiMax, Bluetooth, GPS, RFID, GPRS and LTE used Radio communication link to transmit/receive high speed data.

Modern society depends to a large extent on reliable and efficient communication. There is a nearly unlimited demand for more affordable, faster and advanced Radio communication technologies, indicating that there will be large industrial opportunities in the future. Smart phones, Tablets PC, Smart TVs, Internet through Wi-Fi, WiMax, and GPRS, are just a few examples of today’s radio communication systems that constantly improve in functionality, performance and cost. In addition, a growing number of concepts and technologies are emerging which will significantly improve areas such as healthcare, safety and security of people, the efficiency of industry and comfort of our homes.

This rapid progress in RF and microwave electronics has created an increasing demand for such a course. The course is intended for the students specializing in Communication and Electronics streams.

The objective of this course is to make student sufficiently well acquainted with the principles of RF and Wireless Systems / Antenna Engineering to be able to design circuits for high-frequency operation. The course aims to develop an understanding of the high frequency electronics, basic analysis techniques for RF network analysis, and fundamental principles of antenna function and characteristics.

Course Outline:

RF Networks: Applications of Smith Chart, Maximum Power Transfer Condition, Design of Matching Networks and Stub Matching. Single and Multi-port Networks, Symmetric and Reciprocal Networks, Scattering Parameters and Scattering Matrix.

Noise and Distortion in RF Systems: Noise Figure, Equivalent Noise Temperature, Non-linearity issues Inter-modulation Distortion (IMD), Harmonic and Inter-modulation Distortion, Gains/Losses, Signal-to-Noise Ratio, Tracking noise and signal level through a complete system. Receiver Sensitivity, Spurious-free and Blocking (Linear) Dynamic ranges.

Mixers: Properties and Characteristics: Conversion Loss/Gain, Noise Figure, RF/IF Isolation, LO/IF Isolation, Mixer as Phase Detector, Mixer Types (Single-ended, Balanced, Double-Balanced, Image Rejection
Amplifiers & Oscillators: Amplifier Design using S-Parameters, Stability, RF Oscillators, Oscillator Phase Noise, VCOs and Injection-locked Oscillators.

Support Circuit Design: Frequency Multipliers, RF Switches, Attenuators, AGCs, Power Splitters / Combiners, Directional Couplers, Phase Shifters.

Systematic Analysis of RF Transceiver System Design: Specifications, Block diagrams, Small Signal Analysis, dB Power, Link Budgets, System Design Trade-offs, Gains/Losses, Signal-to-Noise, Probability of Error, Bit Error Rate, E_b/N_0, Link Margin, Tracking Noise and Signal level through a complete system.


References:


Evaluation (tentative):

Mid-Semester Examination:  50%
End-Semester Examination:  50%
Total marks out of 100 will be converted to a letter grade using a 10-point scale.

Online Mechanism of Delivery of Lectures: Using Cisco Webex