Approval: 12th Senate Meeting

Course Name **:** Radiating systems

Course Number **:** EE621

Course Credits **:** 3-1-0-4

Prerequisite **:** PH 521 - Electromagnetic Theory,

EE 507 - Transmission lines and microwave engineering.

Intended for **:** UG/PG Electrical Engineering: MS, M.Tech, PhD, B.Tech = 3rd year, 4th Year

Distribution **:** Discipline Elective for BTech (3es and 4th year), MTech in EE, MS and PhD in the area

Semester : Odd

Preamble: This course is an advance course towards antenna design and engineering. This course will familiarize student with different practical aspects of antenna design and radiation mechanism. Apart from conventional antenna engineering, many latest areas such as : Printed antennas, multilayer antennas, broadband techniques, antennas integrated with EBG and metamaterial structures, diversity antennas for cellular communication and beam forming mechanism are also added in this course.

Course objective: To understand following aspect of Antenna Engineering

a) Antenna radiation mechanism, field and polarization analysis.
b) Antenna tuning and optimization.
c) Frequency and pattern reconfigurablity
d) Antenna array mechanism

Course Contents:

1. **Basic antenna theory –** Basic dipoles theory: Flared transmission lines, Field equations, Dipoles, Monopoles, Antenna transmission and radiation parameters, Antennas polarisation, Antenna miniaturization and Chu–Harrington limit **[10]**

2. **Standard antennas** – Loops, Folded dipoles, Helical antennas, Yagi-Uda, Spiral antennas, antenna-impedance matching and tuning techniques. Aperture theory and equivalence principle, Slot antennas, Horn antennas, leaky wave antennas, Vivaldi antennas **[10]**

3. **Printed and planar antennas –** Microstrip antennas and feeding techniques, broad-band techniques for printed and planar antennas, fractal geometries, printed monopoles and dipole structures, antennas for cellular communication, diversity/MIMO techniques. **[10]**

4. **Reflector and Dielectric resonator antennas** – Reflector theory, Parabolic reflector and feeding techniques. Dielectric resonators: Radiation mechanism from DRA, Feeding techniques for DRA **[7]**

5. **Array theory** – Array synthesis of linear elements, Linear and Planar arrays, Active and passive beam scanning, Excitation techniques in Array, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier-transform method, and Woodward-Lawson method. **[11]**

6. **Frequency Selective Surfaces and EBG Structures for antennas –** Effects of EBG and FSS structure on Planar and non-planar antennas. Metamaterial Inspired antennas. Antenna design and parameter analysis using EM simulators **[8]**

Note: All the Units will have tutorials. Every unit will include recent research paper analysis. In the end of this course a presentation assignment will be conducted in which student present recent development in the area of antennas. The presentation can be in the form of literature survey or simulation results or matlab code program.

Text Book:

1. J.D Kraus, "Antennas", 2nd edition, TMH Publications
2. C. A. Balanis, " Antenna theory, analysis and design", 3rd Edition, Wiley-publications

Reference:

1. Ramesh Garg, P. Bhartia, I Bhel, A. Ittipiboon, "Microstrip antenna design hand book", Artech House publications.
2. Girish Kumar, K. P. Ray, "Broadband Microstrip antennas", Artech House publications
3. Ben. A. Munk, "Frequency Selective surface theory and design", Wiley publications.
4. Fan Yang & Y. Rahmat. Samii, "Electromagnetic Band-gap structures in Antenna Engineering", Cambridge University Press, 2009