ECE 604 Electromagnetic Field Theory

Instructor: Professor W.C. Chew, x4-4502, Wang 3053, (wcchew), (m) 217-390-9653
Office Hours: Tue: 3:00-4:00 pm, Wed: 8:00-9:00 pm, Thu: 3:00-4:00 pm.
(Unofficial) TA: Boyuan ZHANG (zhan3241) and Jie ZHU (zhu797), Assist. Instructor: Dr. Dongyeop NA (na32).
Secretary: Lori Carte, Wang 2080 (lcarte)
Recommended Textbook: Fields and Waves in Communication Electronics, S. Ramo, J.R. Whinnery, and T. Van Duzer, 3rd Ed. (The course will be taught from lecture notes at https://engineering.purdue.edu/wcchew/)
Supplementary Texts: Electromagnetic Wave Theory, J.A. Kong. ECE 350X notes. Theory of Optical and Microwave Guides notes. Waves and Fields in Inhomogeneous Media, Chap. 1. Classical Electrodynamics, J.D. Jackson. Electromagnetic Noise and Quantum Optical Measurements, H.A. Haus.
Fall 2020, Online Tue Thu 1:30 – 2:45 pm
Very Tentative Course Outline (Revised Sep 9, 2020)

	Tue		**Thu**
Week 1, Aug 25-27	1. Introduction, Maxwell's equations.	2. Maxwell's equations in differential operator form.	3. Wave equation. Electrostatics. Static Green's function.
Week 2, Sep 1-3	4. Magnetostatics. Vector potential. Boundary conditions. Jump conditions.	5. Biot-Savart law. Conductive media interface. Instantaneous Poynting's theorem.	6. Time-harmonic fields, phasors. Complex power. (delivered by Dr. NA)
Week 3, Sep 8-10	7. More on constitutive relation. Uniform plane wave. Polarization.	8. Anisotropic media, uniaxial media. Lorentz force law. Drude-Lorentz-Sommerfeld model	9. Waves in gyrotropic media.
Week 4, Sep 15-17	10. Complex Poynting's theorem. Lossless condition.	11. Transmission lines.	**EXAM 1** 12. Transmission lines—impedance matching.
Week 5, Sep 22-24	13. Multi-section transmission line. Duality principle.	14. Single interface reflection and transmission. TIR.	15. Brewster angle, surface plasmon polariton. Homomorphism with TL.
Week 6, Sep 29-Oct 1	16. Waves in layered media. Phase and group velocity. Transverse resonance.	17. Gen. transverse resonance. Dielectric WG.	18. Hollow waveguides. Rectangular WG.
Week 7, Oct 6-8	19. Rect. WG. Circular WG. Quasi TEM and hybrid modes.	20. Homomorphism of waveguides and TM lines.	21. Multi-junction waveguides. Cavity resonators.
Week 8, Oct 13-15	**Fall Break**		**EXAM 2** 22. Q of cavity resonators.
Week 9, Oct 20-22	23. Scalar and vector potential formulation.	24. Circuit theory revisited.	25. Hertzian dipole, radiation by antennas and sources.
Week 10, Oct 27-29	26. Radiation and far field approx.	27. Radiation by dipole array.	28. Types of antennas.
Week 11, Nov 3-5	29. Uniqueness principle.	30. Reciprocity theorem.	31. Equivalence theorem, Huygens' principle.
Week 12, Nov 10-12	32. Shielding, image theory.	33. Paraxial wave equation. High frequency scattering.	**EXAM 3** 34. Rayleigh scattering. Mie scattering.
Week 13, Nov 17-19	35. Plane wave expansion of point source field.	36. Comptational EM, numerical methods.	37. FDTD, Yee algorithm.
Thanksgiving Nov 24-26			
Week 14, Dec 1-3	38. Quantum theory of light.	39. Coherent state of light.	review
Week 15, Dec 7	**FINAL EXAM** TBD		

HW=100 pts, EXAMS 1, 2, 3=300 pts, FINAL EXAM=200 pts, TOTAL=600 pts