

## PHYS 8202: Advanced Electromagnetic Theory II

- Instructor: Dr. M. Bachmann  
Room: Physics Bldg. 309  
Phone: 706-542-3013  
Email: bachmann@smsyslab.org  
Course website: [www.smsyslab.org/teaching.html](http://www.smsyslab.org/teaching.html)
- Topics: The course extends the classical description of electrodynamics, as discussed in part I, toward a quantum field theoretical generalization. This will include the relativistically covariant formulation and its incorporation into Lagrange's and Hamilton's theory of the motion of charged particles and their interaction with electromagnetic waves. After introducing the field theoretical framework, field quantization concepts such as the canonical operator approach and the path-integral formalism will be discussed and applied to scattering processes of matter and light. In this context, systematic perturbation expansions will require the introduction of calculation methods for the corresponding Feynman diagrams. Beyond that, if time, extended topics might cover particle symmetries and the generalization of the electromagnetic theory by including weak and strong forces.
- References: There is a large number of textbooks covering course-relevant material, e.g., W. Greiner and J. Reinhardt, *Field Quantization* (Springer, 1996); *Quantum Electrodynamics*, 4th edition (Springer, 2009); M. Kaku, *Quantum Field Theory: A Modern Introduction* (Oxford, 1993); M.E. Peskin and D.V. Schroeder, *An Introduction to Quantum Field Theory* (Westview, 1995); M. Srednicki, *Quantum Field Theory* (Cambridge, 2007); T. Banks, *Modern Quantum Field Theory* (Cambridge, 2008). For path-integral quantization, see: R.P. Feynman and A.R. Hibbs, *Quantum Mechanics and Path Integrals* (Dover, 2010); H. Kleinert, *Path Integrals in Quantum Mechanics, Statistics, Polymer Physics, and Financial Markets*, 5th edition (World Scientific, 2009).
- Class: Tuesday and Thursday, 2:00–3:15pm, room 254 Physics Bldg.
- Office Hours: Will be discussed in class when schedules are known.
- Exams: Midterm and Final. The midterm exam will be in March and the final exam will be in May (dates to be announced). In both exams, own hand-written lecture notes and homework solutions are admitted, but no books or printed scripts. Excused midterm exam absence causes the grade of the final exam to be substituted for the midterm exam; unexcused absence results in grade zero. Missing the final exam without documentable reason entails failing the course. If the instructor decides that final exam absence was excusable, an oral make-up exam will be set up.
- Homework: There will be graded assignments on a regular basis (probably bi-weekly). The given deadlines will be enforced strictly and late homework is not accepted. No submission via email. Teamwork is acceptable, even encouraged, but each student must hand in an own copy of homework solutions with all names of team members indicated.

Grade:  $\text{Total Grade} = (2 \times \text{Homework} + \text{Midterm} + \text{Final}) / 4$

Grading: [100,85]: A; (85,82.5]: A<sup>-</sup>; (82.5,80]: B<sup>+</sup>; (80,70]: B; (70,67.5]: B<sup>-</sup>; (67.5,65]: C<sup>+</sup>; (65,55]: C; (55,52.5]: C<sup>-</sup>; (52.5,40]: D; (40,0]: F

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