

UNC Charlotte
Department of Physics and Optical Science

**Undergraduate
HANDBOOK
For Dual Majors in Physics and Electrical,
Computer, or Mechanical Engineering**

Fall 2015



UNC CHARLOTTE

College of Liberal Arts & Sciences

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What is a Dual Degree in Physics and Engineering?

Engineering students at UNC Charlotte have the opportunity to earn both an engineering degree and a B.S. Physics degree simultaneously. These two degrees are awarded at the same time and are called dual degrees. Our dual degree programs are designed to broaden and enhance the education of students in the engineering programs. With forethought and planning, students can complete both degree programs in four years due to the overlap in the physics and engineering programs. The dual degree program does not change the core requirements for the B.S. Electrical Engineering, B.S. Computer Engineering, or B.S. Mechanical Engineering in any way. Graduates of the dual degree program in physics and engineering receive a thorough education in physics in addition to the applied and specialized skills they acquire in the engineering programs.

Dual Degree Requirements

Physics and Electrical Engineering

To obtain a dual B.S. degree in Electrical Engineering and Physics, an undergraduate student must complete all requirements for the B.S.E.E. degree as established by the Department of Electrical and Computer Engineering. In addition, the student must complete 12 hours of upper division physics courses specified by the Department of Physics and Optical Science with an average grade of C or above. To meet the upper division physics requirements, students must complete the following courses: PHYS 3121 (Classical Mechanics), PHYS 4241 (Quantum Mechanics), and 6 elective hours (at the 3000-4000 level) chosen from a list of approved courses available from the Department of Physics and Optical Science. These 6 hours of Physics elective credit must be taken under PHYS course numbers. A B.S. in Physics under this program will be awarded at the same time as or after the B.S.E.E.; the B.S. in Physics degree will not be awarded in advance of the engineering degree.

Dual degree students complete the “W” in the major requirement through their Engineering degree requirements. Students in this dual degree program are not required to fulfill the College of Liberal Arts & Sciences foreign language requirement (see the CLAS General Education section in the *Undergraduate Catalog* for additional information).

Physics and Computer Engineering

To obtain a dual B.S. degree in Computer Engineering and Physics, an undergraduate student must complete all requirements for the B.S.Cp.E. degree as established by the Department of Electrical and Computer Engineering. In addition, the student must complete 12 hours of upper division physics courses specified by the Department of Physics and Optical Science with an average grade of C or above. To meet the upper-division physics requirements, students must complete the following courses: PHYS 3121 (Classical Mechanics), PHYS 3141 (Introduction to Modern Physics), PHYS 4231 (Electricity and Magnetism), PHYS 4241 (Quantum Mechanics). Students must also complete MATH 2241. A B.S. in Physics under this program will be awarded at the same time as or after the B.S.Cp.E.; the B.S. Physics degree will not be awarded in advance of the engineering degree.

Dual degree students complete the “W” in the major requirement through their Engineering degree requirements. Students in this dual degree program are not required to fulfill the College of Liberal Arts & Sciences foreign language requirement (see the CLAS General Education section in the *Undergraduate Catalog* for additional information).

Physics and Mechanical Engineering

To obtain a dual B.S. degree in Mechanical Engineering and Physics, an undergraduate student must complete all requirements for the B.S.M.E. degree as established by the Department of Mechanical Engineering. In addition, the student must complete 12 hours of upper division physics courses specified by the Department of Physics and Optical Science with an average grade of C or above. To meet the upper division physics requirement, students must complete the following courses: PHYS 3141 (Introduction to Modern Physics), PHYS 4231 (Electromagnetic Theory I), PHYS 4241 (Quantum Mechanics I), and 3 elective hours (at the 3000-4000 level) chosen from a list of approved courses available from the Department of Physics and Optical Science. These 3 hours of Physics elective credit must be taken under a PHYS course number. It is strongly suggested that students take PHYS 3220 (Mathematical Methods in Physics) as the elective course, unless the student is also a Mathematics major or minor. A B.S. in Physics under this program will be awarded at the same time as or after the B.S.M.E.; the B.S. in Physics degree will not be awarded in advance of the engineering degree.

Dual degree students complete the “W” in the major requirement through their Engineering degree requirements. Students in this dual degree program are not required to fulfill the College of Liberal Arts & Sciences foreign language requirement (see the CLAS General Education section in the *Undergraduate Catalog* for additional information).

Who do I Contact for More Information?

If you need more information about the dual degree program, would like to schedule and advising appointment, or would like information about how to declare the Physics degree, please contact

Dr. Thomas Suleski
704-687-8159
tsuleski@uncc.edu

Dual Degree Checklist B.S. Electrical Engineering and B.S. Physics

PHYS 3121		(Fall only; pre-requisites ECGR 2112, MATH 2171; pre or co-requisite MATH 2241)
PHYS 4241		(Fall only; pre-requisites PHYS 3141, MATH 2241, MATH 2171, PHYS 3121)
PHYS elective		(see list below; consult catalog for required pre-requisites)
PHYS elective		(see list below; consult catalog for required pre-requisites)

Suggested Schedule

Fall 3rd Year
PHYS 3121

Spring 3rd Year
PHYS elective

Fall 4th Year
PHYS 4241

Spring 4th Year
PHYS elective

Students must take PHYS 3121 before taking PHYS 4241.

Approved PHYS electives

PHYS 3160 – Astrophysics I

PHYS 3161 – Astrophysics II

PHYS 3220 – Mathematical Methods in Physics

PHYS 3900 – Research for Credit (Requires approval of Physics Department)

PHYS 4110 – Biomedical Optics

PHYS 4140 – Nuclear Physics

PHYS 4181 – Solid State Physics

PHYS 4222 – Classical Mechanics II

PHYS 4242 – Quantum Mechanics II

PHYS 4271 – Waves and Optics

Dual Degree Checklist

B.S. Computer Engineering and B.S. Physics

PHYS 3141		Fall and Spring; pre-requisite PHYS 2102 and MATH 1241 both with a grade of C or better; pre or co-requisite MATH 1242; this class is a pre-requisite for PHYS 4241
PHYS 3121		Fall only; prerequisites ECGR 2112 and MATH 2171; pre or co-requisite MATH 2241
PHYS 4231		Spring only; pre-requisites PHYS 3121, MATH 2171, and MATH 2241
PHYS 4241		Fall only; pre-requisites PHYS 3141, MATH 2241, MATH 2171, PHYS 3121
MATH 2241		

Suggested Schedule

Fall 3rd Year

PHYS 3121
MATH 2241 (or Spring 3rd year)

Spring 3rd Year

PHYS 3141

Fall 4th Year

PHYS 4241

Spring 4th Year

PHYS 4231

Students must take PHYS 3121 before taking PHYS 4241.
Students must take MATH 2241 before taking PHYS 4231.

Dual Degree Checklist B.S. Mechanical Engineering and B.S. Physics

PHYS 3141		Fall and Spring; pre-requisite PHYS 2102 and MATH 1241 both with a grade of C or better; pre-requisite MATH 1242; this class is a pre-requisite for PHYS 4241
PHYS 4231		Spring only; pre-requisites MEGR 2144, MATH 2171 and 2241; PHYS 3220 is strongly suggested as a pre-requisite for this course
PHYS 4241		Fall only; pre-requisites PHYS 3141, MATH 2241, MATH 2171, MEGR 2144; PHYS 3220 is strongly suggested as a pre-requisite for this course
PHYS elective		see list below; consult catalog for required pre-requisites; PHYS 3220 is strongly suggested as this elective course.

Suggested Schedule

Fall 3rd Year

PHYS 3220

(=PHYS elective, strongly suggested)

Spring 3rd Year

PHYS 3141

Fall 4th Year

PHYS 4241

Spring 4th Year

PHYS 4231

Approved PHYS electives

PHYS 3220 – Mathematical Methods in Physics – strongly suggested

PHYS 4232 – Electromagnetic Theory II

PHYS 4242 – Quantum Mechanics II

PHYS 4271 – Waves and Optics

PHYS 3160 – Astrophysics I

PHYS 3161 – Astrophysics II

PHYS 3900 – Undergraduate Research (requires permission of Undergraduate Advisor)

PHYS 4110 – Biomedical Optics

PHYS 4140 – Nuclear Physics

PHYS 4181 – Solid State Physics

SELECTED PHYSICS COURSE DESCRIPTIONS

PHYS 2101. Physics for Science and Engineering I. (3) Prerequisite: MATH 1241 with a grade of C or above. First semester of a two-semester calculus-based introductory sequence in general physics. Topics include kinematics and dynamics of particles, momentum, work, energy, conservation laws, simple harmonic motion, and mechanics of rigid bodies. Three lecture hours each week. (Fall, Spring, Summer)

PHYS 2101L. Laboratory I. (1) Pre- or corequisite: PHYS 2101. Experiments selected from motion on an inclined plane, circular motion, momentum and energy in collisions, torques, and conservation laws. Use of the computer for organizing, graphing and analyzing data. Two laboratory hours each week. *If a student has completed PHYS 1101L with a grade of C or above in a previous semester, the student is exempted from taking PHYS 2101L.* (Fall, Spring, Summer) (Evenings)

PHYS 2102. Physics for Science and Engineering II. (3) Prerequisites: PHYS 2101 and MATH 1242, both with grades of C or above. Second semester of the calculus-based introductory sequence in general physics. Topics include electric charge, electric fields, and magnetic fields. Three lecture hours each week. (Fall, Spring, Summer)

PHYS 2102L. Laboratory II. (1) Prerequisite: PHYS 2101L (or 1101L). Pre- or corequisite: PHYS 2102. A continuation of PHYS 2101L. Experiments selected from series and parallel circuits, RC circuits, EMF and terminal potential difference, electromagnets, and magnetic induction. Two laboratory hours each week. *If a student has completed PHYS 1102L with a grade of C or above in a previous semester, the student is exempted from taking PHYS 2102L.* (Fall, Spring, Summer) (Evenings)

PHYS 3121. Classical Mechanics I. (3) Prerequisites: PHYS 3101 (or ECGR 2112) and MATH 2171, both with grades of C or above. Pre- or corequisite: MATH 2241. Topics include Newtonian mechanics, kinetic energy, work and potential energy, harmonic oscillators, projectiles and charged particles without and with viscous friction, linear and angular momentum, vector algebra and coordinate transformations, Taylor expansions, mathematical analysis using complex numbers, Fourier series analysis of vibrational motions. (Fall)

PHYS 3141. Introduction to Modern Physics. (3) Prerequisite: PHYS 2102 (or PHYS 1102) and MATH 1241, both with grades of C or above. Pre- or corequisite: MATH 1242. Topics include: Special relativity, quantization of charge, light, and energy, the nuclear atom, wavelike properties of particles, introduction to nuclear reactions and applications, introduction to solid state physics, and introduction to particle physics. (Fall, Spring)

PHYS 3160. Astrophysics I (Stellar Astrophysics). (3) Prerequisites: PHYS 3141 and MATH 2171 or permission of instructor. An introduction to stellar structure and evolution. Topics covered include observational techniques, the interaction of light and matter, spectral classification, stellar structure and energy transport, nuclear energy sources, evolution off the main sequence, variable stars, and stellar remnants. (Spring) (Odd years)

PHYS 3161. Astrophysics II (Interstellar Matter and Galaxies). (3) Prerequisites: PHYS 3141 and MATH 2171 or permission of instructor. An introduction to the structure and contents of

galaxies. Topics covered include the interstellar medium, star formation, galactic kinematics, galactic structure and evolution, active galaxies, and cosmology. (Fall), (Odd years)

PHYS 3220. Mathematical Methods in Physics. (3) Prerequisites: PHYS 2102, PHYS 3101, and MATH 2241 with grades of C or above. Optional pre- or corequisite: MEGR 3121 (for PHYS/MEGR dual majors in place of PHYS 3101 prerequisite). Topics include: distribution functions, solutions to ordinary and partial differential equations, boundary value problems, Fourier analysis, vectors and matrices, vector calculus, and complex variables. (*Fall*)

PHYS 3900. Undergraduate Research. (1-3) Prerequisites: PHYS 3282 and 3283 and permission of the Department Undergraduate Studies Committee. Independent research experience under the supervision of faculty member. May be repeated once with permission of the department. Up to three credit hours of PHYS 3900 may be applied toward the physics degree requirement of “additional PHYS hours at the 3000/4000 level” with approval of the Departmental Undergraduate Studies Committee. (On demand)

PHYS 4110. Introduction to Biomedical Optics. (3) Prerequisites: PHYS 3141 and MATH 2171 both with grades of C or above. Pre- or corequisite: PHYS 3121 or MEGR 2144. This course will cover the basic principles underlying tissue optics, laser-tissue interactions, and optical imaging, microscopy, and spectroscopy for medical applications. (Spring)

PHYS 4140. Nuclear Physics. (3) Prerequisites: PHYS 3141 and MATH 2171, both with grades of C or above. Pre- or corequisite: PHYS 3121 (or MEGR 2144). A study of the nucleus, radioactivity, nuclear reactions, fission, fusion, interactions of radiation with matter and measurement of radiation. (Spring)

PHYS 4181. Solid State Physics. (3) Prerequisite: PHYS 4241 or permission of department. An introduction to solid-state physics. Topics include: crystal structures, reciprocal lattices, phonons, free electron Fermi gases, band structures, and electrical, magnetic, and optical properties of metals, semiconductors, and insulators. Three lecture hours each week. (Spring) (Even years)

PHYS 4222. Classical Mechanics II. (3) Prerequisites: PHYS 3121 and MATH 2241. Continuation of PHYS 3121. Topics include Lagrangian mechanics, two-body central force problems, coupled oscillators and normal modes, Hamiltonian mechanics, non-inertial frames, rigid body motion. (Spring)

PHYS 4231. Electromagnetic Theory I. (3) Prerequisites: PHYS 3121 or MEGR 2144; PHYS 3220 or MATH 2242; and MATH 2171 with grades of C or above. The first course of a two-semester sequence. Topics include: vector analysis, electrostatics and electric fields in matter. Three lecture hours each week. (*Spring*)

PHYS 4232. Electromagnetic Theory II. (3) Prerequisites: PHYS 4231 with a grade of C or above. A continuation of PHYS 4231. Topics covered include magnetostatics, electrodynamics, electromagnetic waves, potentials and fields. Three lecture hours each week. (Fall)

PHYS 4241. Quantum Mechanics I. (3) Prerequisites: PHYS 3141, PHYS 3121 (or MEGR 2144), PHYS 3220 (or MATH 2241) and MATH 2171, all with a grade of C or above. Topics include blackbody radiation, solutions of the time-independent Schrodinger equation, unbound and bound

states, the infinite square well, the harmonic oscillator, the hydrogen atom, spin operators, and the Stern-Gerlach experiment. (Fall)

PHYS 4242. Quantum Mechanics II. (3) Prerequisite: PHYS 4241 with a grade of C or above. A continuation of PHYS 4241. Topics include: perturbation theory, atoms in external electric and magnetic fields, the Stark and Zeeman effects, the WKB approximation, selection rules for electromagnetic radiation, scattering theory, multielectron atoms, electrons in solids, Bose- Einstein and Fermi-Dirac distributions. (Spring)

PHYS 4271. Waves and Optics. (3) Prerequisite: MATH 2171 with a grade of C or above. Corequisite or pre-requisite: PHYS 3121 (or MEGR 2144). Topics include ray analysis of common optical elements, wave properties of light, the superposition of periodic and non-periodic waves, and selected topics from geometrical and physical optics. (Fall)