



Sir Isaac Newton: On the Shoulders of Giants

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WCU
WEST CHESTER
UNIVERSITY

STUDENT HANDBOOK

DEPARTMENT OF PHYSICS
& ENGINEERING

West Chester University of Pennsylvania

Last modified July 2, 2021

Sir Isaac Newton: On the Shoulders of Giants



Key can be found at:

<http://spencertomberg.com/Newton%20descriptions.html>

1. Inertia: Newton's First Law of Motion
2. Newton's Second Law
3. Newton's Third Law
4. The Fundamental Theorem of Calculus
5. "Thus $2/0$ is double to $1/0$ & $0/1$ is double to $0/2$, for multiply the 2 first & divide the 2ds by 0, & there results $2/1:1/1$ & $1/1:1/2$ "
6. The Limit Definition of a Derivative
7. Finite Difference Equations
8. Newton's Method, also called the Newton-Raphson Method.
9. Sine and Cosine Taylor Series Expansion
10. Same as #9
11. Newton's Binomial
12. A vector's statement of Newton's Third Law
13. These equations demonstrate the principal of inertia.
14. The Universal Law of Gravitation
15. The Gravitational Constant
16. Kepler's Third Law -- The Law of Periods
17. Kepler's Second Law-- The Law of Areas
18. Escape Speed
19. Terminal Speed subject to a Drag Force
20. Hooke's Law
21. Coulomb's Law
22. Bernoulli's Equation
23. Buoyant Force
24. Tension and Compression
25. The Color Wheel
26. Newton's Rings
27. Wave Interference Condition
28. Heat Transfer by Conduction
29. Heat Transfer by Radiation
30. Speed of Sound in a Medium
31. Air pressure in a sound wave

DEPARTMENT OF PHYSICS & ENGINEERING

West Chester University of Pennsylvania

Website: <http://www.wcupa.edu/sciences-mathematics/physics>

Department contact information: Department of Physics & Engineering
SECC 367
West Chester University
West Chester, PA 19383

Office Manager: Donna Baun

Phone: 610.436.2497

Fax: 610.436.3013

My Academic Advisor: _____

Advisor Email: _____

Please remember to see your Academic Advisor at least once each semester to review your schedule for the following semester and to have your scheduling flag removed so that you are permitted to schedule your classes. Keep your advisor apprised if the semester is going well or if you are encountering difficulties.

This Handbook does not take the place of the Undergraduate Catalog or the class schedule. And it certainly does not replace face-to-face advisement conducted with Physics and Engineering professors. You may also derive valuable insights by speaking with other majors in Physics and Engineering.

Other sources of Academic Policy, Rules and Regulations, Degree Requirements, etc.:

Ram's Eye View
Undergraduate Catalog

These documents can be accessed on-line.

Most Honored and Esteemed Physics/Engineering Major,

On behalf of the faculty, staff and the other majors in our three Physics and Engineering programs, I would like to welcome you to the Department of Physics & Engineering at West Chester University of Pennsylvania. Our department has a long tradition of excellence. For over the 50 years the Department has been recognized as the home of one of the region's high-quality Physics programs. This tradition of quality continues with the launch of our new Biomedical Engineering Program. The alumni of our programs are reminders of our rich history, one that emerges from the faculty's devotion to educational excellence and its engagement in cutting edge research. West Chester University is among the most selective schools in the region (currently with an acceptance rate of 42%), and the Department of Physics & Engineering is more selective still. You have our pledge of support as you undertake the challenges ahead.

Our undergraduate program begins with courses designed to help you build a strong foundation, regardless of your prior background. Upper division courses deepen your understanding of the basics while introducing more modern and advanced topics. All Physics programs in the department include a capstone, upper-division sequence of laboratory courses, where you have an opportunity to choose from many different experiments, ranging from classic work that measures fundamental constants of nature to experiments that probe the quantum mechanical properties of matter. In these laboratory courses, you will develop techniques and skills that permit you to critically analyze the experimental uncertainties in your data and present your experimental results professionally in written and in oral formats. In the Biomedical Engineering Program, the senior design capstone project provides multiple opportunities to engage with local, national, and international companies and hospital systems to design solutions to their biomedical problems. We also strongly encourage our majors to participate in current research with Physics and Engineering faculty or with faculty from other departments.

Our aim is to prepare you for whatever career path you choose – in industry or consulting, teaching at the secondary school level, or continuing your education in graduate school. We believe that a strong background in physics and engineering is excellent preparation for whatever lies ahead. To help you develop a program that is appropriate for your goals, and to help you meet the challenges that lie ahead, we encourage you to speak with your advisor often – even before you take your first physics or engineering course here.

We also believe in making the department a pleasant and productive place for students and the faculty. As one illustration, we gather for tea weekly at 3 p.m. on Thursdays when classes are in session. As another, we grant 24-hour access to department spaces and rooms most often used by students. Our Society of Physics Students and Biomedical Engineering Society are very active groups and welcome your participation.

I wish you continued success as a member of the Department of Physics & Engineering.

Sincerely,

Matthew M. Waite, Ph.D.
Associate Professor and Chair
Department of Physics & Engineering

THE FACULTY OF PHYSICS & ENGINEERING

Aptowicz, Dr. Kevin B.

Professor

B.S. Electrical Engineering, Columbia University

M.S. Electrical Engineering, University of Colorado

Ph.D. Applied Physics, Yale University

SECC 365

610-436-3010

kaptowicz@wcupa.edu

Areas of scholarly interest: Aerosol particle characterization via elastic light scattering; Physics of soft matter, investigating phase transitions with colloidal particles, jamming transitions

Chen, Dr. Tianran

Associate Professor

B.S. Physics, Zhejiang University, Hangzhou, China

Ph. D. Physics, University of Minnesota, Minneapolis

SECC 358

610-436-3563

tchen@wcupa.edu

Areas of scholarly interest: Computational materials physics; theory in nanocrystal assemblies, superconducting grains and topological insulators

Huang, Dr. Zhongping

Professor

B.S. Energy Engineering, Zhejiang University, Hangzhou, China

M.S. Energy Engineering, Zhejiang University, Hangzhou, China

Ph.D. Mechanical Engineering, University of Kentucky

SECC 304

610-436-3563

Zhuang2@wcupa.edu

Areas of scholarly interest: Artificial Organs, Hemodialysis, Cryobiology, Lyophilization and Freeze Drying, HVAC and Cryogenics.

Kandalam, Dr. Anil K.

Associate Professor

B.S. Physics, Osmania University, Hyderabad, India

M.S. Physics, University of Hyderabad, Hyderabad, India

Ph. D. Physics, Michigan Technological University

SECC 360

610-738-0596

akandalam@wcupa.edu

Areas of scholarly interest: Computational materials physics; investigating bare and supported nanoclusters/nanoparticles; novel cluster-assembled materials, nano-bio hybrid systems, and catalytic activity of metal-based nanoparticles.

Mitchell, Dr. Brandon J.
Associate Professor
B.A. Adolescence Ed., SUNY Fredonia
M.S. Physics, Lehigh University
Ph.D. Physics, Lehigh University

SECC 357
610-436-3387
bmitchell@wcupa.edu

Areas of scholarly interest: Epitaxial growth of III-Nitrides and their material and structural properties; Energy-transfer mechanisms of defect centers in gallium nitride (GaN); Rare-earth doping of GaN for optoelectronic (LED) and spintronic applications, which involves the characterization of their optical, electrical and magnetic properties

Morrison, Dr. Ian A.
Associate Professor
A.B. Physics/Astronomy, Bowdoin College
M.A. Physics, UCSB
Ph.D. Physics, University of California Santa Barbara

SECC 359
610-436-3297
imorrison@wcupa.edu

Areas of scholarly interest: High-energy theoretical physics, including classical and quantum gravity, AdS/CFT, early-universe cosmology, conformal field theory, quantum field theory in curved spacetime, and quantum entanglement

Placone, Dr. Jesse K.
Assistant Professor
B.S. Biomedical Engineering, Johns Hopkins University
Ph.D. Materials Science and Engineering, Johns Hopkins University

SECC 352
610-436-2832
jplacone@wcupa.edu

Areas of scholarly interest: Biomaterials, 3D printing, Cell and Tissue engineering. Focuses on the development, functionalization, and characterization of 3D printed materials for tissue engineering applications; interrogates cell-cell and cell-substrate interactions to provide well characterized systems for investigating cancer metastasis to bone.

Pfeil, Dr. Shawn
Associate Professor
B.S. Physics, University of California San Diego
M.A. Physics, University of California Santa Barbara
Ph.D. Physics, University of California Santa Barbara

SECC 363
610-430-4084
spfeil@wcupa.edu

Areas of scholarly interest: Biomedical physics, device physics, protein folding, microfluidics, nanophotonics, fluorescence spectroscopy, single-molecule spectroscopy

Ramo, Dr. Nicole
Assistant Professor
B.S. Mechanical Engineering, Kettering University
Ph.D. Bioengineering, Colorado State University

SECC 353
nramo@wcupa.edu

Areas of scholarly interest: Mechanical testing and characterization of soft biological tissues including the brain and spinal cord, viscoelasticity, engineering education

Sudol, Dr. Jeffrey J.
Associate Professor
B.S. Physics, Macalester College
Ph.D. Physics, University of Wyoming

SECC 362
610-436-2572
jsudol@wcupa.edu

Areas of scholarly interest: Solar Physics, investigating magnetic field changes during solar flares, dynamics of the early evolution of planetary systems

Thornton, Dr. Robert J.
Professor and Assistant Chair
B.S. Mechanical Engineering, Lehigh University
B.S. Engineering Physics, Lehigh University
Ph.D. Astronomy, University of Hawaii

SECC 364
610-436-2614
rthornton@wcupa.edu

Areas of scholarly interest: Astronomical instrumentation, in particular Cosmic Microwave Background experiments.

Waite, Dr. Matthew M.
Associate Professor and Chair
B.S. Physics, Gettysburg College
Ph.D. Physics, University of Delaware

SECC 369
610-436-2573
mwaite@wcupa.edu

Areas of scholarly interest: Surface science and materials science, investigating thin film growth and characterization, spintronics applications, production of nanoparticles

The Department of Physics & Engineering

All administrative functions of the Department of Physics and Engineering, and most student classrooms and laboratories, are housed in the Science and Engineering Center and the Commons (SECC) building. All the faculty research laboratories are in the complex, though Physics and Engineering professors have been involved in research projects that have taken them and their students to other universities and to places as far away as Japan and Chile.

The department offers undergraduates a broad and thorough understanding of the fundamentals of physics and engineering. Though the minimum requirements for each degree program is specified in the sample curricula found in this handbook, you may take mathematics or other science courses in addition to the courses required by the university, the College of the Sciences and Mathematics and your major in the department. The University also offers an Honors Program, and Physics and Engineering majors have been invited to join that program in the past and have found it to be a rewarding experience. Students with a strong interest in another field have the option of declaring a double major. Many students choose to supplement their classroom experience with research. Both volunteer and some paid positions do exist in individual research groups in Physics & Engineering. If you have an interest in conducting supervised research, please speak with the faculty member whose project interests you; the research specialties of the faculty are listed in this Handbook.

Students whose academic focus is in another field but wish to engage in further study in physics or engineering have the option of taking classes in our department or even declaring a minor in Physics. The Physics minor consists of 19 credit hours; details of specific requirements can also be found in this handbook as well as the Undergraduate Catalog.

Expectations of Academic Integrity

Students in all our programs are expected to adhere to the highest professional ethical standards for academic integrity and conduct. If you are in any doubt as to whether a particular action or submission engenders an ethical issue, do not hesitate to consult with your course instructor, research supervisor, or any of the department faculty. Please also consult the university's policies on student academic integrity which can be found in the Undergraduate Catalog and the WCU Student Handbook.

Research Opportunities for Students

Members of the faculty of Physics and Engineering hold the doctoral degree, and most are actively engaged in research; their areas of research are indicated above. Their works are nationally and internationally recognized with publications in prestigious journals. Undergraduates interested in participating in research activities are encouraged to speak with faculty members directly, asking whether their current projects can involve a student. If circumstances permit, undergraduate research can be undertaken for course credit. Permissions of the faculty member and the Department Chair are required.

Scholarships/Awards

The Robert M. Brown Endowed Scholarship for Physics was established in 1997 by Mr. Robert M. Brown. Partial tuition scholarships are awarded annually on a competitive basis to students in the physics program.

In addition, the Dr. Michael F. Martens Award, established by the West Chester Lions Club, is given annually to students who have shown outstanding achievement in Physics. Awards are determined by the department's faculty. Other awards include the Benjamin Faber Award in Physics and Mathematics, the Diane and Roger Casagrande Scholarship for students in the 3-2 Physics-Engineering 3-2 program, the Russell K. Rickert Award for Research Excellence, the Faculty Recognition Award for outstanding achievement in Physics, the Richard and Jeanette Merion Scholarship, the Dr. Gary Pascuzzo Scholarship, and the Yarosewik Family Scholarship for B.S.Ed. majors. These awards are granted annually at an induction ceremony for new members of the West Chester University Chapter of Sigma Pi Sigma, the national Physics honor society.

The Lei and Song Li Family Biomedical Engineering Scholarship is given annually to Biomedical Engineering undergraduate students. Dr. Li and his family established this scholarship to support undergraduates in the Biomedical Engineering Program who meet selection criteria based upon their performance at West Chester University.

Undergraduate Degree Programs in Physics and Engineering

The Department of Physics & Engineering offers three undergraduate degree programs:

1. The B.S. in PHYSICS is designed as preparation for graduate school or careers in government or industry. The curriculum includes a strong foundation in physics, mathematics and the humanities. Courses in the curriculum also develop communication skills and include a strong element of laboratory work that develops technical and analytical skills. A wide choice of electives in the program provides the flexibility to develop a minor in a related area of interest.
2. The B.S. in PHYSICS/B.S. in ENGINEERING is a cooperative, dual-degree, five-year engineering program with The Pennsylvania State University at University Park, Case Western Reserve University, or with Thomas Jefferson University. Columbia University offers a 3-2 program but only on a competitive basis. In these programs, a student spends three years at West Chester University and two at one of our affiliated universities and earns two degrees, a B.S. in Physics from West Chester University and a B.S. in the engineering field taken at the affiliated university.
3. The B.S. in BIOMEDICAL ENGINEERING is designed to prepare students for professional careers in biomedical engineering (BME) industry, graduate programs, and other professional programs. Courses in this degree program will provide students with a range of training to prepare them for entering the biomedical engineering workforce. Students will build and strengthen their written and oral communication skills that are critical to work effectively in their future careers. The hands-on laboratory work and senior design will develop the students' technical, analytical, and engineering skills.

For admission to the Physics programs, most students should have completed, in addition to the general University requirements, one year each of high school chemistry and physics, and a minimum of three years of mathematics, including algebra and trigonometry, and be prepared to start calculus. Any student with a deficiency must complete WRT 120 and MAT 161 with grades of C- or better to be admitted to the program.

For admission to the Biomedical Engineering program with SAT/ACT scores, most students should have completed, in addition to the general University requirements, one year each of high school biology and physics or chemistry, and a minimum of three years of high school mathematics, including algebra and trigonometry, and be prepared to start calculus. In addition, an SAT Math score of 530 (or equivalent ACT Math score) or better and an SAT Comprehensive (Math + Critical Reading) score of 1100 (or equivalent ACT Composite score) or better are expected of matriculating Biomedical Engineering program students.

For admission to the Biomedical Engineering program without SAT/ACT scores, most students should have completed, in addition to the general University requirements, one year each of high school biology and physics or chemistry, and a minimum of

three years of high school mathematics, including algebra and trigonometry, and be prepared to start calculus. In addition, an average of GPA of 3.0 in these classes and overall high school GPA of 3.3 or better are expected of matriculating Biomedical Engineering program students.

These programs can also be found on the Internet:

<http://www.wcupa.edu/sciences-mathematics/physics/>

BACHELOR OF SCIENCE - PHYSICS

120 semester hours

1. General education requirements: see the Undergraduate Catalog (48 semester hours).
2. Physics courses (44 semester hours)
PHY 170, 175, 180, 240, 300, 310, 320, 350, 370, 420, and 430; an additional nine credits in physics must be chosen from available electives at or above the 300 level.
3. Mathematics courses (18 semester hours)
MAT 161*, 162, 261, 315 (or 311 and 343)
*Also fulfills general education requirement.
4. Chemistry courses (8 semester hours)
CHE 103* and 104; **CRL** 103* and 104
*Also fulfills general education requirement.
5. Free electives (17 semester hours)

Students must maintain a GPA of 2.0 or greater in their physics courses. Transfer students graduating from the B.S. Physics program must complete a minimum of 22 credits in the Physics and Engineering Department at West Chester University. Physics courses at the 300-level or higher must be completed with a grade of C or higher to graduate. Physics majors shall not be permitted to repeat any single Physics course more than once, nor shall any Physics major repeat three or more separate Physics courses. Students may petition the department for ONE (1) exception to ONE (1) of the department requirements for graduation.

BACHELOR OF SCIENCE IN EDUCATION - PHYSICS

There continues to be a strong demand for qualified high school physics teachers. Physics is one of the key elements for a variety of STEM (Science, Technology, Engineering, Mathematics) disciplines, whose presence in high schools continues to increase. While many of the courses B.S. Ed. majors at WCU take will be in the Department of Physics and Engineering, the degree itself is overseen by the College of Education and Social Work (<https://www.wcupa.edu/education-socialWork/>).

COOPERATIVE PHYSICS/ENGINEERING PROGRAM

The Department of Physics and Engineering offers multiple 3+2 Physics-Engineering Programs. These are dual-degree programs in which a student typically spends three years at West Chester and two years at one of our partner institutions, after which a student holds a B.S. in Physics from West Chester University and a bachelor's degree in engineering from the partner institution. Currently, WCU has agreements with Penn State University (main campus), Thomas Jefferson University, and Case Western Reserve University. Columbia University is also part of the 3-2 program, but admission is offered only on a competitive basis.

Admission to one of the affiliate engineering institutions is contingent, among other things, upon a recommendation from the Department of Physics and Engineering and the student having maintained the overall average for the specific engineering program. Check with an advisor in Physics & Engineering for updates on program availability, course and GPA requirements.

Requirements:

1. General education requirements see Undergraduate Catalog. (48 semester hours)
2. Physics & Engineering courses
PHY 170, 175, 180, 240, 300, 310, 320, **BME** 120 and 220; an additional nine credits in physics at or above the 300 level must be chosen, depending on the engineering area selected
3. Mathematics courses
MAT 161*, 162, 261, and 315 (or 311 and 343)
*Also fulfills general education requirement.
4. Chemistry courses
CHE 103* and 104; **CRL** 103* and 104
*Also fulfills general education requirement.

Students must maintain a GPA of 2.0 or greater in their physics courses. Transfer students intending to transfer into the 3-2 Physics/Engineering Program must contact the Department Chair, who will assign an adviser that will inform them of program requirements for the various 3-2 articulation agreements. Physics courses at the 300-level or higher must be completed with a grade of C or higher to graduate. Majors shall not be permitted to repeat any single physics course more than once nor repeat three or more separate physics courses. Students may petition the department for ONE (1) exception to ONE (1) of the department requirements for graduation.

Minor in Physics (19 semester hours)

The program can be used as technical preparation to complement work in other scientific or nonscientific areas, e.g., business majors interested in careers in technologically oriented industries, majors interested in technical or scientific sales, English majors interested in technical writing, or social science majors interested in the area of energy and the environment.

Required:

- 1) PHY 130 or PHY 170
- 2) PHY 140 or PHY 180
- 3) PHY 240
- 4) Select 9 additional credits in physics (PHY) courses numbered 200 or above. At least 6 credits must be from courses numbered 300 or above.

Transfer students must take a minimum of six credits at West Chester at the 300 level or above. A 2.0 GPA or better must be maintained in all physics courses.

BACHELOR OF SCIENCE – BIOMEDICAL ENGINEERING

125mester hours

1. General catalog requirements: see the Undergraduate Catalog. (48 semester hours).
2. Biomedical Engineering courses (50 semester hours)

BME 110, 120, 220, 230, 310, 315, 325, 335, 345, 355, 365, 401, 402, 410, 420, 450; and an additional nine credits in Biomedical Engineering must be selected from available technical electives.

3. Biology courses (7 semester hours)

BIO 110, 265

4. Physics courses (8 semester hours)

PHY 170 and 180

5. Mathematics courses (18 semester hours)

MAT 125, 161, 162, 261, 315

6. Chemistry courses (11 semester hours)

CHE 103, 104, and 230; **CRL** 103 and 104

The minimum credit requirement for graduation with a degree of Bachelor of Science in Biomedical Engineering is 125. In addition to university graduation requirement of a cumulative GPA of 2.0 or above, the Biomedical Engineering students must earn a cumulative Tech GPA of 2.2 or above, and earn a C+ or above in 300 level and above BME courses for graduation. The Tech GPA is calculated based on all engineering courses, mathematics and science courses attempted at West Chester University.

Transfer students are subject to the “General requirements for admission of transfers” of West Chester University. In addition, Transfer students from two-year and four-year US accredited institutions must have a minimum cumulative GPA of 2.2 out of 4.0 and must have completed with a grade of “C” or better in at least one calculus course and one science course in chemistry, physics, or biology that are approved for transfer credit toward degree requirements in the Biomedical Engineering Program.

West Chester students who are enrolled in other majors, including in the Exploratory Studies Program are required to meet the following requirements by the end of their first semester for transfer into the Biomedical Engineering program:

1. Completion of FYE with grade of “C” or better;

2. Completion of MAT 131 (pre-Calculus) or MAT 161 (Calculus I) with grade of “C” or better;
3. Completion of CHE 103 with grades of “C” or better
4. Earn a cumulative GPA of 2.2 or higher.

Pre-Medical Program for Physics and Engineering Students

A student in any major, including Physics and Engineering may apply to the Pre-Medical Program. Students interested in pursuing admission to medical school or other health professional schools should consider applying to the Program in addition to pursuing their degree in Physics or Engineering. The Pre-Medical Program prepares students for applying to health professional school in medicine, in medical physics and for careers in research in medicine. Supervised by a Pre-Medical Committee, the program consists of an individualized selection of course work, personal counseling, academic support and optional junior-year medical research at a medical school or research institute. Students in the program are expected to maintain the high standards of performance necessary for health professional school admission. Pursuing jointly the B.S. in Physics or B.S. in Biomedical Engineering and preparing for admission to medical school will require more than the 120 credits of either degree alone.

Students who are interested in careers in medical physics are also encouraged to avail themselves of the services offered by the Pre-Medical Program office. Generally, students complete a B.S. in Physics and then go on to graduate work in a masters-level program in Medical Physics lasting two years. Such a program meets the academic and career interests of technically prepared college graduates who seek to combine their interests in graduate physics with growing career opportunities in the field of medicine. The practice of modern medical physics requires highly educated and well-trained problem solvers to aid in development, implementation and on-going maintenance of highly technical clinical equipment.

For additional information or to apply, visit <https://www.wcupa.edu/sciences-mathematics/preMed/>.

Department of Physics & Engineering

ADVISING POLICIES, PROCEDURES AND PRACTICES

The Department of Physics & Engineering embraces the concept that effective academic advising is a collaborative process between the student and the faculty advisor. We believe that effective advising should assist students in achieving their academic, professional and personal goals. Faculty advisors strive to provide accurate and timely information that can serve as the basis for students making decisions regarding their academic program of study. The effectiveness of academic advising is contingent upon individual students taking ownership and responsibility for their educational and career goals by assuming an active role in the classroom and apprising themselves of the policies and requirements for graduation. The department is responsible for providing a supportive environment where students receive quality academic advising, and, when circumstances warrant, be referred to other campus resources that will provide students assistance to help students succeed.

Academic advising in Physics and Engineering programs

Academic advising is a critical component for the successful completion of any of the Physics and Engineering degree programs. The academic advisor's role is to ensure that the requirements for the major are clearly delineated on the student's program of study and to apprise students of potential logistical issues. The advising sheet for the student's program of study is an important reference document in this connection. The advisor also serves as a consultant for the student as the academic plan is prepared and executed, serves as a source of information about university academic policies and procedures, and serves as a resource to discuss and investigate options available to the students after graduation. Though the academic advisor serves as a source of information and advice, ultimately it is the student's responsibility to ensure that all programmatic requirements for the degree are met. With the student's active involvement in the advising process, the student is empowered to make informed decisions about their program of study and their academic plan.

Responsibilities of the academic advisor:

- Assist students as they develop their academic program of study by exploring their individual interests, abilities and goals, by aiding students in the formulation of an academic plan and by counseling students in the selection and sequencing of courses that meet their degree requirements. The advisor will give each student an advising sheet appropriate for the program in which the student is enrolled.
- Identify university resources that may be of value to students and make appropriate referrals.
- Apprise students of relevant university policies if changes to a student's academic plan are contemplated.

Responsibilities of the student:

- Schedule meetings with the academic advisor at appropriate times during the semester. These include discussions regarding a coming semester's course selections and apprising the academic advisor as to academic progress during the semester.
- Be aware of pre-requisites for courses to be taken.
- Be aware of important, relevant deadlines and then meet them.
- In processing required forms, obtain required signatures.
- Review University policies and procedures as needed.
- Develop and clarify the values and goals that impact academic decisions and communicate them effectively to the academic advisor.
- Monitor progress and, if necessary, modify the academic plan for future semesters.
- Understand the requirements for the major (and minor, if applicable).
- Understand the general education requirements
- Have knowledge of the Undergraduate Catalog and the information contained in the Undergraduate Course Schedule.
- Examine the academic record for accuracy on a regular basis and monitor progress towards completion of the degree.
- Save all academic advising, course registration information and grade reports.
- Seek advisement prior to taking a course at some other institution and provide official transcripts for courses taken elsewhere.
- Recognize the need for resources when circumstances warrant and use them.

Academic Coordinator

The scheduling and some advising needs of first-year physics majors are served by professional staff and the Academic Coordinator. The Academic Coordinator for Physics and Engineering majors is Ms. Jessica McMahan, whose office is Room 121B of Anderson Hall. The Academic Coordinator is an expert in university systems and structures, and will be very useful when needing assistance in navigating them, including (a) the technical process of scheduling and registering for classes, (b) seeking information about various campus offices, (c) negotiating university policies related to academic and other areas, including general education, degree, and other university requirements, and (d) seeking additional support or access to faculty advisors as needed. The Academic Coordinator works with your assigned Faculty Advisor and your Department Chair to coordinate support for you, especially during your first year at West Chester University.

Ms. Jessica McMahan
Anderson 121B
610-436-1733
jmcmahan@wcupa.edu
<http://meetme.so/JessicaMcMahan>

The Academic Plan

The foundation of a student's academic plan is the advising sheet appropriate to the Physics and/or Engineering program being followed by the student. The academic advising sheet should frequently be reviewed in its totality, and from this a general plan should be developed in which the student identifies the courses needed to complete all degree requirements and minor requirements over the remaining semesters of study. In addition, advising sheets inform students of special requirements particular to the program and the department. This academic plan should be shared with the academic advisor for comments and suggestions and should be brought to every advising session. The plan will likely be tentative and based upon course availability, the possible need to repeat courses, and other unforeseen circumstances. Students should create the plan in writing and update their plan every semester. The Degree Progress Report (DPR), available on MyWCU, serves as an important complement to the academic advising sheets, and should also be checked as a student advances toward the student's chosen degree.

Department of Physics & Engineering: Advising Structure

Prior to matriculation, each student is scheduled for an advising session with the Chair of the Department who ensures that the Fall semester schedule is appropriate. The Chair also counsels the new students regarding strategies for success and cautions them about the likely pitfalls to avoid. The Chair also apprises them of their responsibilities in future meetings with their academic advisor and gives them a copy of the Student Handbook which includes the advising sheet for the student's program of study. The Department Chair also mentions that the student will be assigned a permanent advisor and gives the name of the advisor.

Currently, the advising structure is:

Pre-matriculation	M.M. Waite
B.S. Physics majors:	T. Chen A. K. Kandalam I. A. Morrison S. Pfeil J. J. Sudol
B.S. Physics/Engineering dual-degree majors:	K. B. Aptowicz B. J. Mitchell R. J. Thornton
B.S. in Biomedical Engineering	Z. Huang J. K. Placone N.L. Ramo

The following pages list the requirements for each of the Physics and Engineering programs. You should use the appropriate sections to plan and record your academic progress. The ultimate responsibility for constructing each semester's schedule is the student's. For University policy information and degree requirements, refer to the WCU Undergraduate Catalog for the year you entered the University. This is your contract with the University and specifies your General Education requirements, provided you maintain full-time status as a student. You may review your requirements with your Academic Advisor. Students are expected to utilize campus e-mail.

Every semester a Scheduling Flag is placed on your account. This Flag generates a 'hold' that prevents you from scheduling until you meet with your Academic Advisor; your advisor removes the flag. This system is designed to assist your selection of the most appropriate coursework to meet graduation requirements in a timely fashion.

SOCIETY OF PHYSICS STUDENTS



Department of Physics & Engineering
West Chester University of Pennsylvania

B.S. Physics Curriculum – Schedule for Graduate School Track & Applied Track
Updated: November 2020

Fall Semester 1

FYE	First Year Experience	4
MAT 161	Calculus I	4
WRT 120	Effective Writing I	3
CHE 103	General Chemistry I	3
CRL 103	Exper. Gen. Chem. I	1
	Total credits:	15

Spring Semester 1

PHY 170	Physics I	4
MAT 162	Calculus II	4
WRT 2XX	Effective Writing II	3
CHE 104	General Chemistry II	3
CRL 104	Exper. Gen. Chem. II	1
	Total credits:	15

Fall Semester 2

PHY 180	Physics II	4
MAT 261	Calculus III	4
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	1
	Total credits:	15

Spring Semester 2

PHY 175	Computational Physics	3
PHY 240	Intro. to Modern Physics	3
MAT 315	Diff Eq & Linear Algebra	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Total credits:	15

Fall Semester 3

PHY 300	Mechanics	3
PHY 310	Intermediate Physics Lab 1	3
PHY 370	Mathematical Physics	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Total credits:	15

Spring Semester 3

PHY 320	Intermediate Physics Lab II	3
PHY 350	Thermodynamics	3
PHY XXX	Physics Elective	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Total credits:	15

Fall Semester 4

PHY 420	Quantum Mechanics - I	3
PHY 430	Electricity & Magnetism - I	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Total credits:	15

Spring Semester 4

PHY XXX	Physics Elective	3
PHY XXX	Physics Elective	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Gen Ed / Free Elective	3
	Total credits:	15

All students must take:

- PHY core courses: PHY 170, 180, 175, 240, 300, 310, 320, 350, 370, 420, 430
- Three PHY electives numbered 300 or above. Eligible PHY Elective courses are:
 - PHY 330: Electronics, offered every year
 - PHY 390: Astrophysics, offered intermittently (in spring)
 - PHY 410: Optics, offered in Fall
 - PHY 425: Quantum Mechanics II, offered intermittently (in spring)
 - PHY 435: Electricity & Magnetism II, offered intermittently (in spring)
 - PHY 480/1: Special Topics, offered in spring

Notes

- PHY courses numbered 300 or above must be completed with a grade of C or better
- Majors shall not be permitted more than one repeat of a Physics course
- Students may complete MAT 311 and MAT 343 in place of MAT 315
- Total number of credits in B.S. Physics Curriculum = 120

Department of Physics and Engineering

West Chester University of Pennsylvania

3-2 Physics-Engineering Dual-Degree Programs (Track A – 95 credits)

Curriculum for students who entered in Fall 2019 or later

Last modified January 1, 2021

B.S. Physics, West Chester University and B.S. Engineering from Case Western University, Columbia University¹, Penn State University, or Thomas Jefferson University

Semester 1

MAT 161	Calculus I	4	M
CHE 103	General Chemistry I	3	S
CRL 103	Exper. Gen. Chem. I	1	
WRT 120	Effective Writing I	3	E
Gen Ed.	First Year Experience	4	G
	Total	15	

Semester 2

MAT 162	Calculus II	4	
CHE 104	General Chemistry II	3	
CRL 104	Exper. Gen. Chem. II	1	
PHY 170	Physics I	4	
WRT 2XX ²	Effective Writing II	3	E
BME 120	Intro CAE	3	
	Total	18	

Semester 3

MAT 261	Calculus III	4	
PHY 180	Physics II	4	
BME 220	Statics	3	
Gen. Ed.	Arts Gen. Ed.	3	A
ECO 111	Princ. of Econ. (Macro)	3	SS
	Total	17	

Semester 4

MAT 315	Diff. Eq. & Lin Alg.	3	
PHY 240	Intro. to Modern Physics	3	
Gen. Ed.	Interdisciplinary	3	I
Gen. Ed.	Humanities Gen. Ed. ²	3	H
PHY 175	Computational Physics	3	
	Total	15	

Semester 5

PHY 300	Mechanics	3	
PHY 310	Inter. Physics Lab I	3	WE, SE
PHY	Physics Elective ²	3	
Gen. Ed.	PHI 180	3	H/ET/J
Gen. Ed.	Bio or ESS	3	S
	Total	15	

Semester 6

PHY 320	Inter. Physics Lab II	3	WE,SE,C
PHY	Physics Elective ²	3	
PHY	Physics Elective ²	3	
	3-2 Elective Course ²	3	
	3-2 Elective Course ²	3	SS
	Total	15	

¹Columbia university admission offered on a competitive basis only.

² Courses should be selected to fulfill program specific requirements. See appendix.

WCU Physics Degree Requirements:

- Majors will not be permitted to repeat any physics course more than once.
- Upper level courses (numbered 300 or above) must be completed with a grade of C (2.0) or higher.
- All Physics electives must be numbered above 300. Speak with your advisor about the appropriate elective for your engineering discipline.

Additional information for students matriculating to **Case Western Reserve University:**

- Available majors are Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Macromolecular Science, Materials Science, Mechanical and Aerospace Engineering, and Systems & Control Engineering.
- The minimum cumulative grade point average is a 3.0. Note: you must also have a cumulative GPA of 3.0 in your math and science classes.
- Complete a minimum of 90 credits hours at WCU.

Additional information for students matriculating to **Columbia University** (for students who started at WCU after Fall 2018, admission is available only by competitive application process):

- Available majors are Applied Mathematics, Applied Physics, Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Computer Science, Earth and Environmental Engineering, Electrical Engineering, Engineering Mechanics, Engineering and Management Systems, Industrial Engineering, Material Science and Engineering, and Mechanical Engineering, and Operations Research.

To be competitive in the application process:

- The required minimum cumulative grade point average is a 3.30.
- A minimum grade of B (3.0) must be obtained on the first attempt in all science and mathematics prerequisite coursework (e.g. MAT 161, 162, 262, PHY 170, 180, CHE 103, and CSC 141).
- Online courses will not be accepted in the matriculation process.

Additional information for students matriculating to **Pennsylvania State University:**

- Available majors are Biological Engineering, Electrical Engineering, Energy Engineering, Engineering Science, Environmental Systems Engineering, General Engineering, Material Science and Engineering, and Mining Engineering. Other majors are not available.
- The required minimum cumulative grade point average is a 3.00. Original grades for courses that were repeated should be used in the calculation.
- A minimum grade of "C" (2.00) in MAT 161, MAT 162, PHY 170, and CHE 103 is required. These courses must be taken at WCU.
- The degree program with Penn State must be completed within three years and is not available to transfer students.

Additional information for students matriculating to **Thomas Jefferson University:**

- Available majors Mechanical Engineering and (General) Engineering with concentrations in Architectural Engineering, Industrial and Systems Engineering, Composites Engineering and Textile Engineering.
- The required minimum cumulative grade point average is a 3.00. Original grades for courses that were repeated should be used in the calculation.

Appendix for Cooperative Physics-Engineering Dual-Degree Programs advising sheet

Course recommendations for students matriculating to **Case Western Reserve University**:

- Students are encouraged to take PHY370 as a physics elective.
- Each specific engineering major has unique additional **recommended** courses. Students should consult the website for the Dual Degree Program at Case Western pertaining to their major of interest for other recommended course. Note: If these courses cannot be fulfilled, they will be integrated into the curriculum, which may possibly extend the program timeline.

Course recommendations for students matriculating to **Columbia University**

- Students should consult the document titled *The Combined Plan Program at Columbia University* for information about foundational and major-specific prerequisite coursework that must be completed at WCU. Some of the engineering majors have three or more major-specific prerequisite courses, which may require an additional course to be taken during one of the semesters.

Course recommendations for students matriculating to **Pennsylvania State University**:

- The 3-2 Elective courses should be selected to satisfy course requirements at Penn State. Recommended courses are: ENG 371 Technical Writing, an Art Course, a Health Course, or a course that fulfills the requirement of a particular major. See Penn State's 'Check Sheet.'

Course recommendations for students matriculating to **Thomas Jefferson University**:

- Physics Elective courses: Students intending to pursue Mechanical Engineering should take PHY 330, PHY 350, and PHY 370.
- General Education courses: For WRT 2XX, students should select WRT 200, 204, or 206. Soc. Sci Gen. Ed., students should select PSY100, PSC101, or PSC343. For Humanities Gen. Ed., students should select HIS100, HIS151, or HIS 152. Details can be found on the WCU Department of Physics and Engineering homepage under Programs → Engineering. At the bottom of the page, click on the link for the B.S. Mechanical Engineering Full Checksheet.

Department of Physics & Engineering
West Chester University of Pennsylvania
B.S. in Biomedical Engineering Curriculum—updated May 29th, 2019

Semester 1

MAT 161	Calculus I	4
CHE 103	General Chemistry I	3
BME 110	Intro. BME	3
WRT 120	Effective Writing I	3
Gen. Ed.	FYE	4
	Total Credits	17

Semester 2

MAT 162	Calculus II	4
CHE 104	General Chemistry II	3
PHY 170	Physics I	4
CRL 103	Chemistry I lab	1
BME 120	Intro CAE	3
	Total Credits	15

Semester 3

MAT 261	Calculus III	4
BIO 110	General Biology	3
PHY 180	Physics II	4
BME 220	Statics	3
CRL 104	Chemistry II lab	1
	Total Credits	15

Semester 4

MAT 315	Diff. Eq. & lin. Alg.	3
BIO 265	Hum. A&P	4
CHE 230	Intro. Organic Chemistry	3
WRT 2xx	Effective Writing II	3
BME 230	Dynamics	3
MAT 315	Diff. Eq. & lin. Alg.	3
	Total Credits	16

Semester 5

BME 310	Engineering Thermodynamics	3
BME 315	BME Lab I	2
MAT 125	Intro. Statistics & Prob.	3
BME 335	Biomaterials	3
PHI 180	Intro. Ethics	3
ECO 112	Economics II	3
	Total Credits	17

Semester 6

BME 325	BME Lab II	2
BME 345	Biotransport Phenomena	4
BME 355	Bioinstrumentation	3
BME 365	Biomechanics	3
Gen. Ed	Hum	3
	Total Credits	15

Semester 7

BME 410	Senior Design I	3
BME XXX	Tech. Elective I	3
BME 401	Senior Seminar I	1
BME 450	Regulatory and GMP	3
Gen. Ed	Art	3
Gen. Ed	Interdisciplinary	3
	Total Credits	16

Semester 8

BME 420	Senior Design II	1
BME XXX	Tech. Elective II	3
BME XXX	Tech. Elective III	3
BME 402	Senior Seminar II	1
Gen. Ed	Diverse Comm.	3
Gen. Ed	Behav. & Soc.	3
	Total Credits	14

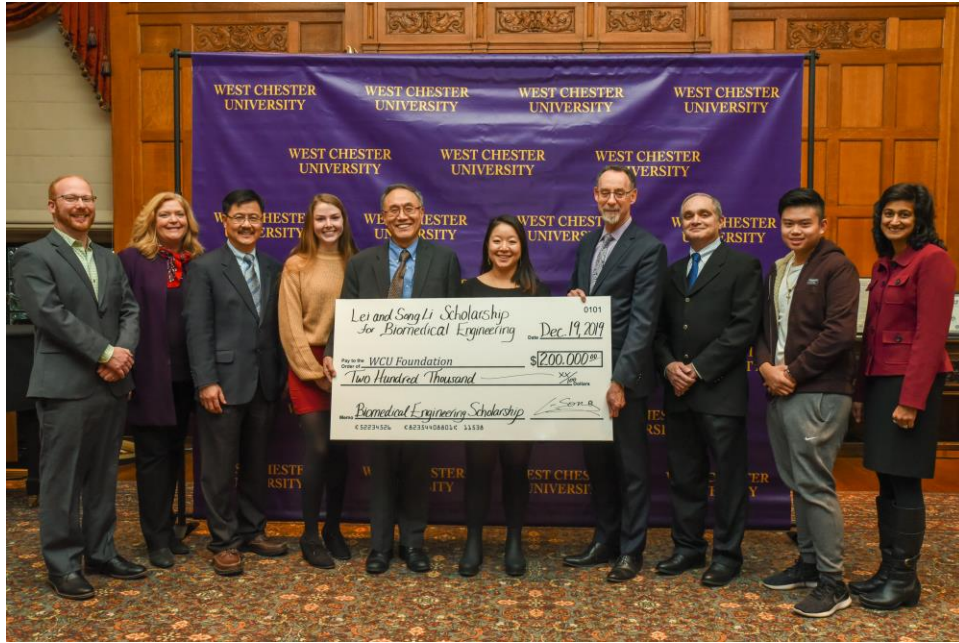
Currently BME we has three technical electives in the 7th and 8th semester. These three technical electives reflect three major areas in BME, i.e., Biomechanics, Bioinstrumentation, and Cell and Tissue Engineering. Technical electives may change depending on enrollment, faculty research focus areas, and interest of the student body. etc. For more information, please contact the BME faculty.



Inaugural Biomedical Engineering class picture



Faculty/student volleyball game



The Lei and Song Family Award in Biomedical Engineering check presentation.



First class picture



West Pharmaceutical Services Biomedical Engineering Scholarship Award

Physics Major's General Education Requirements

Basic Requirements: 120 Semester hours at or above the 100 level, and a GPA of at least 2.0

Students leaving for partner institutions in our 3+2 programs **must** complete all general education requirements prior to leaving WCU. Please check your degree progress report on myWCU.

ACADEMIC FOUNDATIONS:

Prefix	Course	Semester	Grade	Credits
FYE (<i>Waive if 24 or more transfer credits</i>)				4
WRT (<i>Waive if Academic Passport eligible</i>) (<i>Waive if Write Survey result is WRT 200</i>)	120 or 123 (<i>based on Write Survey result</i>)			3 - 4
WRT (<i>Waive if Academic Passport eligible</i>)	200, 204, 205, 206, 208 or 220			3
MAT	161			4
SPK Emphasis (<i>Waive if Academic Passport eligible</i>) <i>[earlier] – Summer 2019: SPK 208 or SPK 230</i> <i>Fall '19 – Spring '22 First Years: 6 credits (any level)</i> <i>Fall '19 – Spring '21 Transfers: all 6 credits WAIVED</i> <i>Fall '21 – Spring '22 Transfers: 3 credits (any level)</i>	208 or 230 (199 transfer) + one other course if required			3 - 6
Diversity (J) ^a				3
Interdisciplinary (I) ^b (<i>Waive if Academic Passport eligible</i>)				3
Ethics (€) (<i>Waive if Academic Passport eligible</i>)				3

a. CAN be used to fulfill other requirements, such as a minor. A single course may fulfill the "I" and "J" requirements.

b. Interdisciplinary courses may **not** be used to fulfill a general education requirement in the distributive areas (science, behavioral and social sciences, humanities, the arts). However, a course may simultaneously satisfy the interdisciplinary and diverse communities requirements.

SCIENCE DISTRIBUTION: One course from the [approved general education course list under that category](#). Second Science Distributive course requirement met through CHE 103 course, required by the major. (*Waive if Academic Passport eligible*)

Prefix	Course	Semester	Grade	Credits
CHE	103			3

BEHAVIORAL & SOCIAL SCIENCE DISTRIBUTION: Two **approved** courses with **different** prefixes **outside of the major** in the list: ANT, ECO, GEO, PSC, PSY, SOC. (*Waive if Academic Passport eligible*)

Prefix	Course	Semester	Grade	Credits
				3
				3

HUMANITIES DISTRIBUTION: Two **approved** courses with **different** prefixes **outside of the major** in the list: HIS, LIT/CLS, PHI. (*Waive if Academic Passport eligible*)

Prefix	Course	Semester	Grade	Credits
				3
				3

ART DISTRIBUTION: One **approved** course **outside** of the major in the list: ARH, DAN, FLM, MHL, THA
(Waive if Academic Passport eligible)

Prefix	Course	Semester	Grade	Credits
				3

WRITING EMPHASIS:

6 credits of Writing Emphasis are met through PHY 310 Intermediate Lab I and PHY 320 Intermediate Lab II.

If 0 – 40 transfer credits, 9 credits of Writing Emphasis courses are required.

If 41 – 69 transfer credits, PHY 310 and PHY 320 are sufficient and no other Writing Emphasis courses are needed.

If 70 or more transfer credits, PHY 310 alone is sufficient and no other Writing Emphasis courses are needed.

Prefix	Course	Semester	Grade	Credits
PHY	310			3
PHY	320			3

SPEAKING EMPHASIS:

- 6 credits of which 3 must come from SPK 208 or 230 (or SPK 199 transfer credit) unless Academic Passport eligible.

All students [earlier] – Summer 2019: requirement is SPK 208 or SPK 230

Fall 2019 – Spring 2022 First Years: requirement is 6 credits Speaking Emphasis (any level)

Fall 2019 – Spring 2021 Transfers: all 6 credits of Speaking Emphasis WAIVED

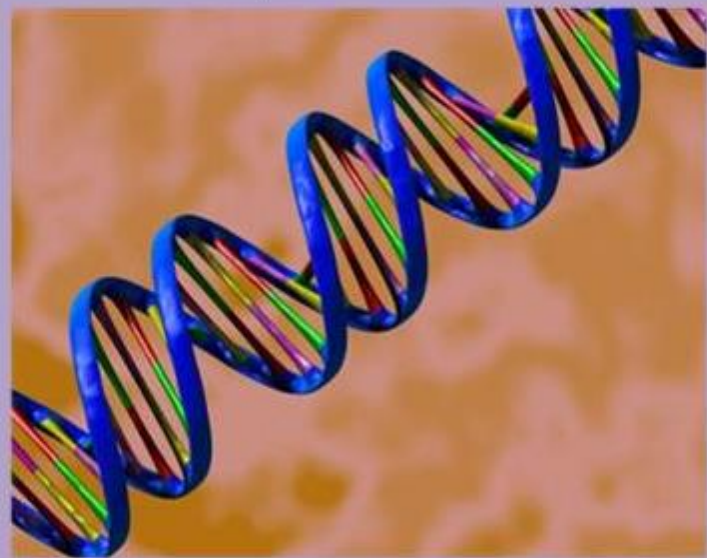
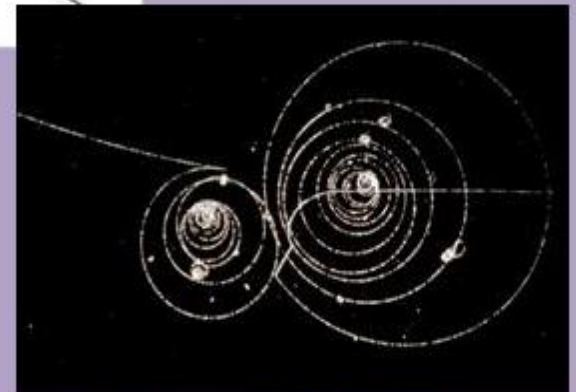
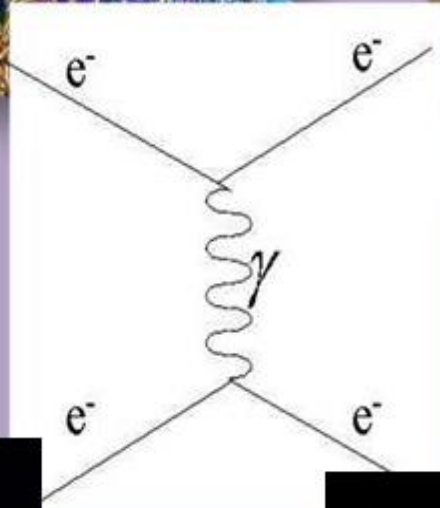
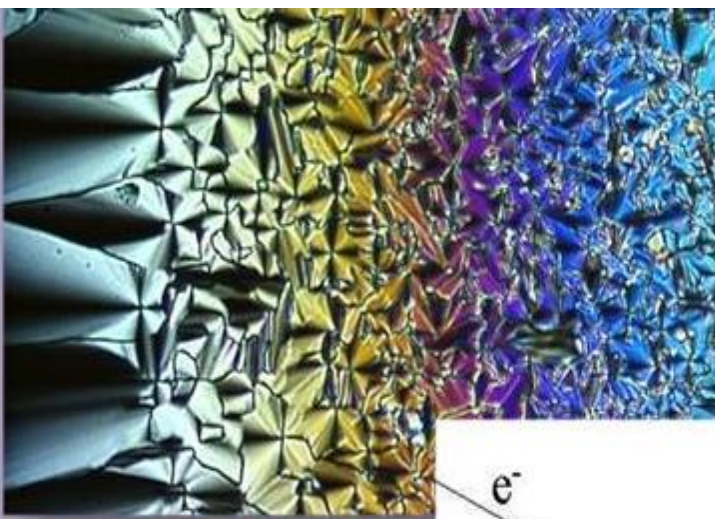
Fall 2021 – Spring 2022 Transfers: requirement is 3 credits Speaking Emphasis (any level)

Prefix	Course	Semester	Grade	Credits
SPK	208 or 230 (or SPK 199)			3
PHY	310			3

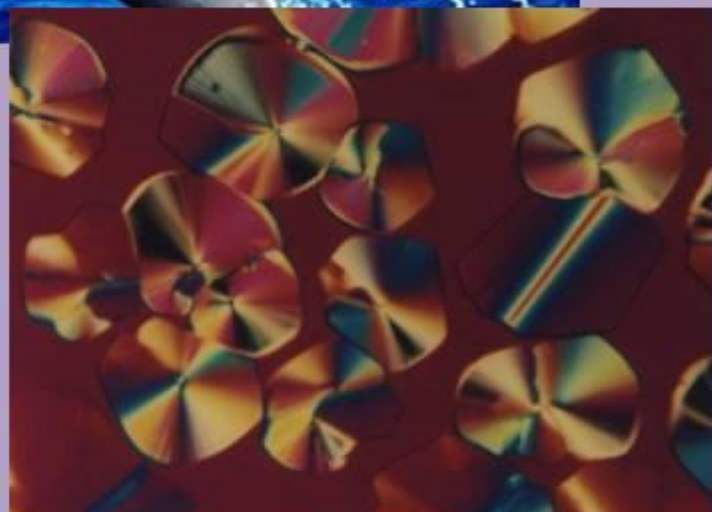
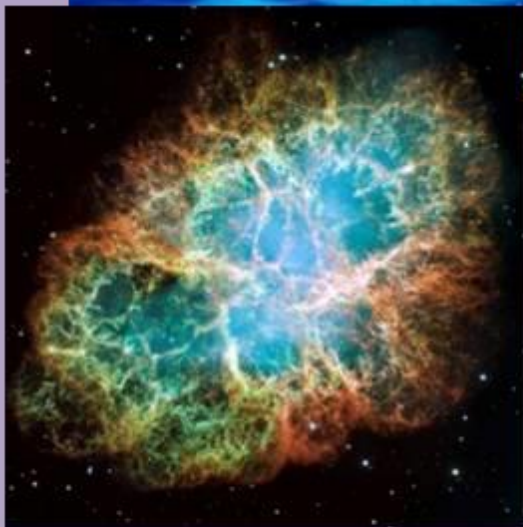
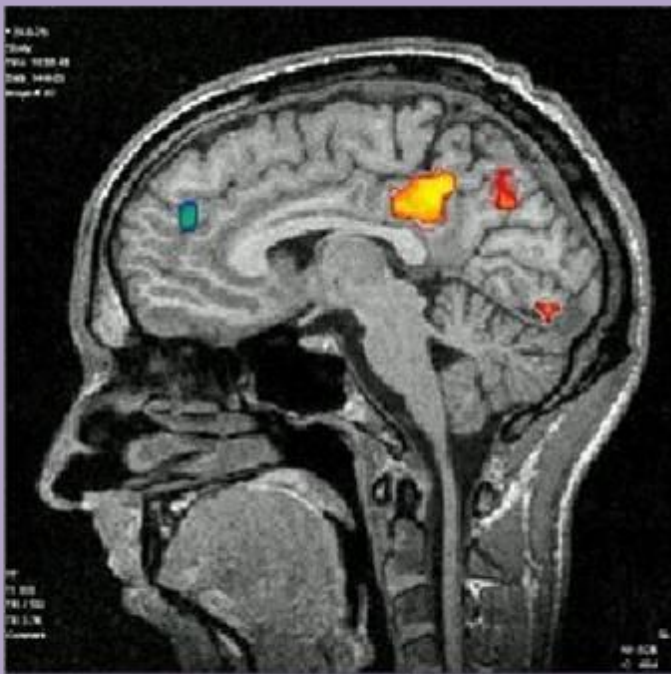
FREE ELECTIVES:

Only if needed to reach 120 credits minimum graduation requirement.

Prefix	Course	Semester	Grade	Credits



Top to bottom, left to right: Liquid crystal (photo: Kenneth D. Singer); Sun in three x-ray wavelengths (photo: SOHO-EIT Consortium, ESA, NASA); Negative nematic (photo: Kent State Liquid Crystal Institute); Feynman diagram of two electrons repelling; Spiral galaxy (photo: NASA); Kaon decay in a bubble chamber (photo: CERN); Jet breaking sound barrier: Flying Wings (photo: copyright © Andreas Zeitler); and model of a DNA strand.



Top to bottom, left to right: Functional MRI image – Project members: D.H.J. Poot, J. Sübers, A.J. den Dekker; A shock wave tracing a spiral path away from the black hole (Copyright © Dr Wolfgang Steffen); Whirlpool Galaxy (photo: NASA); Spinner Dolphin (photo: Alamy); Crab Nebula supernova remnant (photo: NASA); and pyramidal liquid crystal (photo: Zeev Luz).