This form is a routing document for the approval of new and revised academic programs. Proposing department should complete this form. For more information, call the Faculty Senate Office at 831-2921.

Submitted by: John Gizis phone number x2668

Department: Physics and Astronomy email address gizis@udel.edu

Date: 15 October 2009

Action: Revise Concentration
(Example: add major/minor/concentration, delete major/minor/concentration, revise major/minor/concentration, academic unit name change, request for permanent status, policy change, etc.)

Effective term 10F
(use format 04F, 05W)

Current degree BS
(Example: BA, BACH, BACl, HBA, EDD, MA, MBA, etc.)

Proposed change leads to the degree of:
(Example: BA, BACH, BACl, HBA, EDD, MA, MBA, etc.)

Proposed name:
Proposed new name for revised or new major/minor/concentration/academic unit
(if applicable)

Revising or Deleting:

Undergraduate major/Concentration:
(Example: Applied Music – Instrumental degree BMAS)

Undergraduate minor:
(Example: African Studies, Business Administration, English, Leadership, etc.)

Graduate Program Policy statement change:
(Must attach your Graduate Program Policy Statement)

Graduate Program of Study:
(Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

Graduate minor/concentration:

List new courses required for the new or revised curriculum. How do they support the overall program objectives of the major/minor/concentrations? (Be aware that approval of the curriculum is dependent upon these courses successfully passing through
Currently students are required to take two advanced classes at the 400 or 600-level in astrophysics, but there are only two such classes allowed. These classes will allow more choice.

**Explain, when appropriate, how this new/revised curriculum supports the 10 goals of undergraduate education: [http://www.ugs.udel.edu/gened/](http://www.ugs.udel.edu/gened/)**

This is a minor revision to fill a hole in the physics requirements, and to make the requirements more flexible.

**Identify other units affected by the proposed changes:**
(Attach permission from the affected units. If no other unit is affected, enter “None”)

None

**Describe the rationale for the proposed program change(s):**
(Explain your reasons for creating, revising, or deleting the curriculum or program.)

Addition of PHYS310 (Thermodynamics): This class provides. Although most students took it anyway it was clear that skipping the class left a significant hole in the student’s understanding of basic physics.

Dropping the PHYS133/144/145 (Introduction to Astronomy): Student exit interviews alerted us that these classes (any one of the three was required), geared mainly toward non-majors were not as useful to the students as we had hoped. Dropping this class allows us to add 310 without changing the number of credits.

Choice: PHYS434/630/632/633/634/635/639/644 (Various advanced astrophysics classes) Currently we require 632 and 633. Because we now teach a greater variety of advanced astrophysics classes than in previous decades, it is appropriate to allow the students the choice of which (equally important) topics to take. Furthermore, because the classes were taught every other year, it was difficult for some students to schedule the required classes, so in practice some students would have to substitute classes. With one (or more) of these classes being taught every semester, students will be able to fulfill their requirements in a timely fashion.

**Program Requirements:**
(Show the new or revised curriculum as it should appear in the Course Catalog. If this is a revision, be sure to indicate the changes being made to the current curriculum and include a side-by-side comparison of the credit distribution before and after the proposed change.)
ROUTING AND AUTHORIZATION:  (Please do not remove supporting documentation.)

Department Chairperson ____________________________ Date ________

Dean of College ____________________________ Date ________

Chairperson, College Curriculum Committee ____________________________ Date ________

Chairperson, Senate Com. on UG or GR Studies ____________________________ Date ________

Chairperson, Senate Coordinating Com. ____________________________ Date ________

Secretary, Faculty Senate ____________________________ Date ________

Date of Senate Resolution ____________________________ Date to be Effective ________

Registrar ____________________________ Program Code ____________________________ Date ________

Vice Provost for Academic Affairs & International Programs ____________________________ Date ________

Provost ____________________________ Date ________

Board of Trustee Notification ____________________________ Date ________

Revised 02/09/2009 /khs
Current Version

DEGREE: BACHELOR OF SCIENCE MAJOR: PHYSICS CONCENTRATION: ASTRONOMY/ASTROPHYSICS

CURRICULUM CREDITS

UNIVERSITY REQUIREMENTS
ENGL 110 Critical Reading and Writing (minimum grade C-) ........................................ 3
First Year Experience (see page 68). ................................................................. 0-4
Discovery Learning Experience (see page 68). ................................................. 3
Three credits in an approved course or courses stressing multi-cultural, ethnic, and/or gender-related course content (see pages 68-70) ....................... 3

COLLEGE REQUIREMENTS
Writing: (minimum grade C-) ........................................................................... 3
A second writing course involving significant writing experience including two papers with a combined minimum of 3,000 words to be submitted for extended faculty critique of both composition and content. This course must be taken after completion of 60 credit hours. Appropriate writing courses are normally designated in the semester’s Registration Booklet. (See list of courses approved for second writing requirement, pages 93-95.)

BREADTH REQUIREMENTS (See pages 95-100)
A total of eighteen credits from Groups A, B and C is required with a minimum of six credits in each group .............................................................. 18
The six credits from each group could be from the same area.

Group A: Understanding and appreciation of the creative arts and humanities.

Group B: The study of culture and institutions over time.

Group C: Empirically based study of human beings and their environment.

MAJOR REQUIREMENTS
Ordinarily, no more than four credits from among PHYS 201 and 207 may be counted toward graduation requirements; similarly no more than four from among PHYS 202, 208. Students interested in majoring in Physics who have taken an introductory sequence other than PHYS 207/208 should consult with a member of the Physics faculty to consider the need for additional introductory courses, for which some additional credit toward graduation may be given with permission of the Physics chair.

All 200-level PHYS courses used to satisfy prerequisites or graduation requirements must be passed with a minimum grade of C-.

PHYS 169 Perspectives: Physics & Astronomy ................................................. 1
PHYS 207/208 Fundamentals of Physics I and II .......................................... 8
PHYS 211 Oscillations and Waves ................................................................. 3
PHYS 309 20th/21st Century Physics ........................................................... 3
PHYS 313 Physical Optics ........................................ 4
PHYS 333 Fundamentals of Astrophysics ......................... 3
PHYS 419 Classical Mechanics I .................................
PHYS 424 Quantum Mechanics ................................... 3
PHYS 449 Introduction to Research ............................... 3
PHYS 460 Computational Methods of Physics .................. 3
PHYS 469 Observational Astronomy ................................ 3
PHYS 632 Astrophysics ............................................. 3
PHYS 633 Stellar Astrophysics .................................... 3
MATH 241/242/243 Analytic Geometry and Calculus A, B and C ...... 12
Additional Credits of Physics or Math at or above the 300 level ........ 12
One of the following .................................................. 6
MATH 302/349 Ordinary Differential Equations and Elementary Linear Algebra
MATH 341/342 Differential Equations with Linear Algebra
One of the following .................................................. 3-4
PHYS144 Concepts of the Universe /PHYS145 Blacks Holes and Cosmic Evolution/
PHYS133 Introduction to Astronomy

Foreign Language or Computer Science: .......................... 0-12
Completion of the intermediate-level course (107 or 112) in a given foreign language.
Number of credits needed and initial placement will depend on number of years of high school study of foreign language. Students with four or more years of high school work in a single foreign language may attempt to fulfill the requirement in that language by taking an exemption examination.

or
Completion of the following Computer Science sequence:
CISC 105 General Computer Science ............................... 3
CISC 181 Introduction to Computer Science ...................... 3
CISC 220 Data Structures ......................................... 3
Additional credits of Computer Science at or above the 260 level .... 3

ELECTIVES
After required courses are completed, sufficient elective credits must be taken to meet the minimum credit requirement for the degree.

CREDITS TO TOTAL A MINIMUM OF ...................... 124
Proposed Version

DEGREE: BACHELOR OF SCIENCE MAJOR: PHYSICS CONCENTRATION: ASTRONOMY/ASTROPHYSICS

CURRICULUM CREDITS

UNIVERSITY REQUIREMENTS
ENGL 110 Critical Reading and Writing (minimum grade C-) .......................... 3
First Year Experience (see page 68) ....................................................... 0-4
Discovery Learning Experience (see page 68) ........................................... 3
Three credits in an approved course or courses stressing multi-cultural, ethnic, and/or
gender-related course content (see pages 68-70) ..................................... 3

COLLEGE REQUIREMENTS
Writing: (minimum grade C-) ................................................................. 3
A second writing course involving significant writing experience including two
papers with a combined minimum of 3,000 words to be submitted for extended
faculty critique of both composition and content. This course must be taken after
completion of 60 credit hours. Appropriate writing courses are normally
designated in the semester’s Registration Booklet. (See list of courses approved for
second writing requirement, pages 93-95.)

BREADTH REQUIREMENTS (See pages 95-100)
A total of eighteen credits from Groups A, B and C is required with a minimum
of six credits in each group ................................................................. 18
The six credits from each group could be from the same area.

Group A: Understanding and appreciation of the creative arts and humanities.

Group B: The study of culture and institutions over time.

Group C: Empirically based study of human beings and their environment.

MAJOR REQUIREMENTS
Ordinarily, no more than four credits from among PHYS 201 and 207 may be counted
toward graduation requirements; similarly no more than four from among PHYS 202,
208. Students interested in majoring in Physics who have taken an introductory sequence
other than PHYS 207/208 should consult with a member of the Physics faculty to
consider the need for additional introductory courses, for which some additional credit
toward graduation may be given with permission of the Physics chair.

All 200-level PHYS courses used to satisfy prerequisites or graduation requirements must
be passed with a minimum grade of C-.

PHYS 169 Perspectives: Physics & Astronomy ........................................ 1
PHYS 207/208 Fundamentals of Physics I and II ..................................... 8
PHYS 211 Oscillations and Waves ......................................................... 3
PHYS 309 20th/21st Century Physics ..................................................... 3
PHYS 310 Introduction to thermal physics...3
PHYS 313 Physical Optics ......................................... 4
PHYS 333 Fundamentals of Astrophysics ........................ 3
PHYS 419 Classical Mechanics I .................................
PHYS 424 Quantum Mechanics .................................. 3
PHYS 449 Introduction to Research ............................... 3
PHYS 460 Computational Methods of Physics .................. 3
PHYS 469 Observational Astronomy ................................ 3
Two of the following 8 courses .......................6
    PHYS 434 Astrophysics and the Origins of Life
    PHYS 632 Astrophysics
    PHYS 633 Introduction to Stellar Astrophysics
    PHYS 634 Physics of the Sun
    PHYS 635 Space Physics
    PHYS 630 Galaxies
    PHYS 639 Selected topics in Astrophysics
    PHYS 644 Elementary Particles and Big Bang Cosmology

MATH 241/242/243 Analytic Geometry and Calculus A, B and C ....... 12
One of the following ............................................. 6
MATH 302/349 Ordinary Differential Equations and Elementary Linear Algebra
MATH 341/342 Differential Equations with Linear Algebra

Additional Credits of Physics or Math at or above the 400 level ........ 12
One of the following ............................................. 3
PHYS 144 Concepts of the Universe / PHYS 145 Black Holes and Cosmic Evolution
PHYS 133 Introduction to Astronomy

Foreign Language or Computer Science: ................................ 0-12

Completion of the intermediate-level course (107 or 112) in a given foreign language. Number of credits needed and initial placement will depend on number of years of high school study of foreign language. Students with four or more years of high school work in a single foreign language may attempt to fulfill the requirement in that language by taking an exemption examination.
or
Completion of the following Computer Science sequence:
CISC 106 General Computer Science .......................... 3
CISC 181 Introduction to Computer Science .................. 3
CISC 220 Data Structures ........................................ 3
Additional credits of Computer Science at or above the 260 level ........ 3

ELECTIVES
After required courses are completed, sufficient elective credits must be taken to meet the minimum credit requirement for the degree.

CREDITS TO TOTAL A MINIMUM OF .................. 124