Graduate Curriculum Committee
September 17, 2008
11:30 a.m., MH 243

Agenda

1. Welcome and Introductions

2. General business
   - Graduate Curriculum procedures and policies
   - Graduate Council website
   - Confirmation of start times for meetings
   - Proxy voting

3. Suspension of the CLM track in Health Sciences MS, COHPA

4. Addition of Planetary Sciences tracks to the MS and PhD in Physics, COS
   - Three split classes

5. Courses and special topics

6. Changes in graduate education

7. Adjournment

University of Central Florida

Deans Office
College of Health and Public Affairs

DEANS OFFICE MEMORANDUM

TO:	PATRICIA BISHOP
FROM:	MICHAEL FRUMKIN
SUBJECT:	DISCONTINUATION OF ENROLLMENT FOR HEALTH SCIENCES MS TRACK: CLINICAL AND LIFESTYLE MEDICINE
DATE:	8/28/08
CC:	AARON LIBERMAN, STEPHEN HOLMES

The College of Health and Public Affairs formally requests that the College of Graduate Studies discontinue enrollment in the Clinical and Lifestyle Medicine Track within the MS in Health Sciences.

The decision to discontinue enrollment in this track has been thoroughly discussed within the College, the Department and Academic Affairs.

Rationale for the Decision:
The decision to discontinue enrollment in this program was based on the lack of academically qualified students. After one year in existence, only one continuing student is in good academic standing at the University.

Effect on Students:
As mentioned previously, there was only one student from the previously admitted cohort that was in good academic standing. The college and program met with this student and offered her the choice of continuing her program of study with one-on-one instruction or being admitted to another graduate program in the College. The student after consultation with the program and her parents chose to switch her enrollment to the Health Sciences masters program.

Students that applied to the program and were admitted we each contacted and were consulted about the decision to discontinue enrollment. One student (a Provost Fellow) decided to enroll in the Health Sciences masters program. A second student had already made a decision to enter a similar program at FIU and a third from the Washington, DC area never returned our repeated phone calls or emails.

Effect on Faculty:
There were two faculty members that were assigned to this program. One faculty member who is tenured in the department has been assigned a full load within the same department however is now teaching classes in a separate track of the same degree program. The other tenure earning faculty member has been assigned a 100% research load for the fall semester.

Effect of Change on Other Units:
The change in shifting the responsibility of the faculty assigned to the Clinical Lifestyle Medicine masters program really has not had any appreciable effect on any other units within the college other that it has provided some additional flexibility of teaching assignments within the Department of Health Professions.

Please let me know if you have any further questions.

PROGRAM PROPOSAL APPROVAL
COVER PAGE

To be used for New or Changed Degree, Track or Certificate Program

Planetary Sciences Track
Name of Program

Physics
Department(s) Coordinating Program

Fall/2008
Proposed Effective Catalog Semester/Year

Please attach a copy of the program proposal. Note the units that have been consulted if duplication of programs or conflict of interest with other units occurs.

This is a:
- [ ] Certificate
- [x] Masters
- [ ] Doctoral
- [ ] New Program
- [ ] Revision to an Existing Program
- [ ] Deletion of Program

If a **new** program, please provide the following information:

Proposed Diploma Description (subject to review): **Planetary Sciences**

Proposed Transcript Description (subject to review): **Planetary Sciences**

Admission Deadlines:

Fall Priority: **January 15**
(for fellowships)

Fall: **June 15**

Spring: **November 1**

Summer: ______

Will students currently active in another program be able to move, and not have to apply, into this program?

- [ ] Yes
- [x] No
- [ ] Unsure

If yes, from which programs? ______

What are the admissions requirements? (If not included in proposal. Provide as an attachment if necessary.)

Who will be the director/coordinator for this program? **Dr. Daniel Britt**

APPROVALS

Department/School Approval: [signature] 3/28/08
Chair/Director — Date

College Approval: [signature] 4/11/08
(After Committee Review) Associate Dean of Graduate Studies — Date

Graduate Studies Approval: ______
Graduate Council — Date

Academic Affairs: ______
Academic Affairs — Date

Planetary Sciences Masters Track Proposal

<u>The purpose of the Planetary Sciences track:</u> Our nation's goals in space exploration require the support of highly trained scientific community. Florida's goals in the development of a Space Industry also require the support and leadership of a Space Science Community. Our objective is to:

- Prepare students to conduct competitive research in astronomy and the planetary sciences.
- Make UCF a top-tier center for research and teaching in the planetary sciences as an extension of and a complement to our region's world-class space industry.
- Create a vibrant planetary science research environment that can attract top students, researchers, and faculty and contribute to the economic development of Florida.

A top tier grad program produces both excellent research and researchers. Graduates from the program will establish a reputation for UCF around the world. This reputation benefits the department and UCF in many ways including attracting high quality faculty, talented graduate students, and enhanced external funding.

<u>Likely Career Outcomes:</u> Planetary Sciences is a vibrant, well-funded field with substantial opportunities for employment at Universities (University of Arizona, University of Hawaii, Cornell University to name a few examples. A full listing of institutions with major Planetary Science employment is attached), NASA and other US government research renters (Jet Propulsion Laboratory, Goddard Spaceflight Center, Ames Research Center, Johnson Space Center, Johns Hopkins Applied Physics Laboratory), Aerospace Companies (Lockheed Martin, Boeing, Ball, Orbital Sciences, Science Applications International Corporation), and private research centers (Southwest Research Institute, The Aerospace Corporation, Space Science Institute, Planetary Science Institute, Lunar and Planetary Institute). Students that complete a Masters Degree Planetary Sciences Track at UCF will have the skills and training necessary to successfully compete for jobs and grants in this dynamic and exciting environment.

<u>Target audience and demonstrated need:</u> Florida has a world-class space industry (Lockheed Martin, Boeing, United Space Alliance to name a few) and world-class space institutions (Kennedy Space Center, Air Force Eastern Test Range), as well as a growing, well-educations, and intensely space-interested population. These sources of students are increasingly demanding a world-class program in Planetary Sciences to support their career advancement and career plans. We have had intense interest and numerous inquires about a Planetary Science track at UCF from current undergraduates, employees of KSC and Lockheed Martin, and students from around the country. In addition, the Planetary Science Faculty of the Physics Department have over $2 million in NASA and NSF grant funding that can support Planetary Science graduate students.

<u>Curriculum:</u>

<u>Masters Requirements:</u> Master's requirements include at least 33 hours of graduate course work as directed by the student's supervisory committee. This must include at least 15 hours of courses from the planetary core listed below and 6 hours of Thesis Preparation with the remainder being electives and directed research classes chosen in consultation with the supervisory committee. At least half of the total credits must be at the 6000 level. No more than 6 hours of independent study may be credited toward the M.S. degree. The Master's Degree in planetary sciences includes a thesis and its defense. There is no non-thesis Master's degree in the planetary sciences track.

Core: The core is designed to give students a broad foundation in the planetary sciences and a rapid training in the data analysis techniques that will be necessary for a successful research and publications.

- **Statistical Physics (PHY 5524):** A study of physical concepts and methods appropriate for the description of systems involving many particles. Ensemble theory, partition functions. Maxwell Boltzmann, Bose-Einstein, Fermi-Dirac statistics.
- **Classical Mechanics (PHY 6246):** Variational principles. Lagrange, Hamiltonian, and Poisson bracket formulations of mechanics. Hamilton's principle of least action. Hamilton-Jacobi theory. Perturbation theory. Continuous systems. Chaos.
- **Either: Computational Physics (PHZ 5156):** Computational methods applied to the solution of problems in many branches of physics; or **Advanced Astronomical Data Analysis (AST 5937):** Advanced techniques for processing astronomical data including defringing, bootstrap and Markov-chain Monte Carlo analysis, advanced model fitting, wavelets, and numerical recipes.
- **Planetary Geophysics (New Graduate Course at the 5000 level):** The physics of planetary surfaces, surface processes, interiors, mineralogy, and reflectance spectroscopy.
- **Advanced Observational Astronomy (New Graduate Course at the 5000 level):** Design of scientific observing programs, acquiring astronomical data sets, applied astronomical data reduction, analysis of sources of observational error, publication of results.
- **Planetary Atmospheres (AST 5165):** The physics and chemistry that govern the behavior of the atmospheres of Earth and other planets including atmospheric dynamics, vertical chemistry, radiative transfer, gas spectroscopy, and cloud microphysics.

Suggested Electives for the Planetary Sciences Track:

- **Origins of Solar Systems (New Graduate Course at the 5000 level):** Formation of planetary systems beginning with the proto-stellar clouds, collapse, condensation, particle-disk interactions, accretion models, formation of satellites, what has been learned from observations of extra-solar planets, and the physics of magnetic fields generated by planetary bodies.
- **Astrobiology (AST 5937):** Interdisciplinary branch of science that deals with the origins, development, and fate of life on Earth and in extraterrestrial environments.
- **Plasma Physics (PHZ 5505):** Introduction to theory and experimental basis of both weakly and highly ionized plasmas. Instabilities, plasma waves, nonlinear effects, controlled thermonuclear fusion.
- **Electrodynamics I (PHY 5346):** Boundary value problems in electrostatics and magnetostatics. Maxwell's equations. EM fields in matter, wave generation and propagation; wave guides, resonant cavities

- **Electrodynamics II (PHY 6347):** Dynamics of charged particles in electromagnetic fields. Antennas; radiation by moving charges; magnetohydrodynamics; multipole radiation and electrodynamics of materials.
- **Quantum Mechanics I (PHY 5606):** Basic postulates of quantum mechanics, operators, eigenvalues, parity, potential wells, harmonic oscillator, time dependent and time independent Schrodinger equation, matrix formulation, and time independent perturbation theory.
- **Quantum Mechanics II (PHY 6624):** Time dependent perturbation theory, exchange symmetry, Dirac Equation, second quantization, and scattering theory
- **Introduction to Wave Optics (OSE 5041):** Electromagnetic foundation of light waves as applied to reflection, diffraction, interference, polarization, coherence, and guided waves.
- **Image Processing (EEL 5820):** Two-dimensional signal processing techniques; pictorial image representation; spatial filtering; image enhancement and encoding; segmentation and feature extraction; introduction to image understanding techniques
- **Fundamentals of Optical Science (OSE 5312):** Microscopic theory of absorption, dispersion, and refraction of materials; wave propagation, introduction to lasers and non-linear optics.

Admission: Students must be specifically admitted to the track. Applications are considered by the Planetary Graduate Committee, to be appointed by the department Chair. This committee is to be chaired by a planetary scientist, will have one member from another research area in the department, and will have at least three members. Admission to the track requires a Bachelor of Science or equivalent, typically in physics, astronomy, geology, geophysics, geochemistry, atmospheric sciences, or planetary sciences. Those without full academic preparation in physics and astronomy, or low scores on the Departmental placement test may be required to complete specified coursework in addition to the core program, as determined by the Planetary Graduate Committee at the time of admission or their Supervisory Committee at a later date.

Supervisory Committee: Within the first half-semester, each student must select, by mutual agreement, a faculty advisor and two other faculty members to serve on his or her Supervisory Committee. One of the faculty members who is not the advisor must be from an area in the department other than planetary science. Changes in the membership of a Supervisory Committee must be approved by the Planetary Graduate Committee. The advisor is expected to meet regularly with the student. The full committee shall meet with the student at least once per semester to review and make recommendations regarding the student's academic progress. A self-funded department researcher who funds and supervises a student's dissertation research may petition the Planetary Graduate Committee to become a member of a student's Supervisory Committee.

Masters Defense: The astronomy track Masters requirement includes a written thesis and its oral defense after the completion of the Masters course work and research. The thesis is a journal-level research paper. The oral defense is a two parts: (1) A public presentation of the research contained in the paper; and (2) private questioning on the detail of the presented research as well as the topics covered in the student's preparation and course work. The written and oral components will be administrated by the student's Supervisory Committee. A student must submit the written Thesis to the Supervisory Committee 14 calendar days before the scheduled oral defense. Committee members are expected to read it and give a preliminary indication as to its acceptability four days after receipt. The preliminary indication of acceptability for a written examination paper is noncommital. Rather, it is intended to avoid obvious failures. By the start of the eighth day before the examination, the official version of the thesis is due, and the Committee must decide whether to allow the oral defense to proceed. If the defense does not proceed, either due to decision of the Supervisory Committee or that of the student, the student is deemed not to have defended. The following outcomes are possible for the defense:

Pass
Pass conditioned on revisions (both) or additional coursework
Retake
Retake after additional coursework
Fail

Passes conditioned on revisions are handled as follows: all committee members sign the appropriate paperwork except the advisor. The advisor signs the paperwork when satisfied with the revisions. Students may only retake a defense once, and must do so within one year, or immediately after the next offering of a required course, whichever occurs later. If the student fails examination a second time or fails to retake the examination within the specified period, the student is dropped from the program.

Participating Faculty:

Professor H. Campins
Assistant Professor J. Harrington
Assistant Professor Y. Fernandez
Assistant Professor J. Colwell
Associate Professor D. Britt
Associate Professor E. Martin

Administration and Start Date: The program will be administered by a committee of Physics Department Planetary Science Faculty. Proposed start date for the track is August 20, 2008.

Building the Program: There are currently few planetary graduate candidates. We propose to initially offer our courses as a mix of linked 4000/5000 level courses for advanced undergraduate and graduate students, and guided reading seminars for graduate students led by the planetary science faculty members. The 4000/5000 courses are linked to have sufficient numbers to support teaching the classes. For the core courses this involves three courses: (1) The proposed Advanced Observational Astronomy will be linked to the undergraduate Techniques of Observational Astronomy (the undergraduate course is requested to be upgraded from the current AST 3722 to the 4000-level). The proposed Planetary Geophysics course will be linked with undergraduate Planetary Geophysics (this course is currently AST 3110 Solar System Astronomy and is being requested to be upgraded to the 4000 level with a name change to Planetary Geophysics). Finally AST 5937 Astronomical Data Analysis is already linked with the undergraduate AST 4762 Astronomical Data Analysis course. The syllabi of the graduate and undergraduate versions of each course are attached for review. This short-term solution is consistent with the practice for previous successful planetary science graduate programs. The other core courses PHY 6246, PHY 5524, and AST 5165 are current stand-alone graduate courses.

Expected Number of Students: Over the first three years of a Planetary Science Masters program it is expected that 2 to 4 students will participate. Currently there is one student in the physics department who will immediately transfer into the Planetary Science Masters program once it becomes available.

Major Employers of Planetary Scientists

US Government Laboratories

- Jet Propulsion Laboratory
- Goddard Spaceflight Center
- Ames Research Center
- Johnson Space Center
- US Geological Survey
- The Smithsonian (Center for Planetary Sciences)
- Johns Hopkins Applied Physics Laboratory
- Los Alamos National Laboratory
- US Naval Observatory
- Lawrence Berkeley National Laboratory
- Marshall Spaceflight Center
- Glenn Research Center
- US Air Force Research Laboratory

Corporations

- Lockheed Martin
- Boeing
- Ball
- Orbital Sciences
- Science Applications International
- BAE Systems
- The Aerospace Corporation
- Raytheon
- General Dynamics
- Northrop Grumman
- Honeywell
- Malin Space Science Systems

Universities:

- University of Arizona (Lunar and Planetary Laboratory)
- University of Hawaii
- California Institute of Technology
- Washington University in St. Louis (McDonnell Center for the Space Sciences)
- University of Colorado (Laboratory for Atmospheric and Space Physics)
- Cornell University
- Arizona State University
- University of Texas
- Brown University
- University of California, Los Angles
- Massachusetts Institute of Technology
- University of California, Berkeley (Center for Integrative Planetary Sciences)
- University of Alaska

University of Virginia

Private Research Institutes

- Southwest Research Institute
- Space Science Institute
- The Carnegie Institution
- Planetary Science Institute
- Lunar and Planetary Institute
- Space Telescope Science Institute

PROGRAM PROPOSAL APPROVAL COVER PAGE

To be used for New or Changed Degree, Track or Certificate Program

Planetary Sciences Track
Name of Program

Physics
Department(s) Coordinating Program

Fall/2008
Proposed Effective Catalog Semester/Year

Please attach a copy of the program proposal. Note the units that have been consulted if duplication of programs or conflict of interest with other units occurs.

This is a:
- [ ] Certificate
- [ ] Masters
- [x] Doctoral

- [ ] New Program
- [ ] Revision to an Existing Program
- [ ] Deletion of Program

If a **new** program, please provide the following information:

Proposed Diploma Description (subject to review): Planetary Sciences

Proposed Transcript Description (subject to review): Planetary Sciences

Admission Deadlines:

Fall Priority: January 15
(for fellowships)

Fall: June 15

Spring: November 1

Summer: ______

Will students currently active in another program be able to move, and not have to apply, into this program?

- [ ] Yes
- [x] No
- [ ] Unsure

If yes, from which programs? ______

What are the admissions requirements? (If not included in proposal. Provide as an attachment if necessary.)

Who will be the director/coordinator for this program? Dr. Daniel Britt

APPROVALS

Department/School Approval: LS Rahman — 3/28/08
Chair/Director — Date

College Approval: [signature] — 4/1/08
(After Committee Review) Associate Dean of Graduate Studies — Date

Graduate Studies Approval: ______
Graduate Council — Date

Academic Affairs: ______
Academic Affairs — Date

Planetary Sciences Ph.D. Track Proposal

The purpose of the Planetary Sciences track: Our nation's goals in space exploration require the support of highly trained scientific community. Florida's goals in the development of a Space Industry also require the support and leadership of a Space Science Community. Our objective is to:

- Prepare students to conduct competitive research in astronomy and the planetary sciences.
- Make UCF a top-tier center for research and teaching in the planetary sciences as an extension of and a complement to our region's world-class space industry.
- Create a vibrant planetary science research environment that can attract top students, researchers, and faculty and contribute to the economic development of Florida.

A top tier grad program produces both excellent research and researchers. Graduates from the program will establish a reputation for UCF around the world. This reputation benefits the department and UCF in many ways including attracting high quality faculty, talented graduate students, and enhanced external funding.

Likely Career Outcomes: Planetary Sciences is a vibrant, well-funded field with substantial opportunities for employment at Universities (University of Arizona, University of Hawaii, Cornell University to name a few examples. A full listing of institutions with major Planetary Science employment is attached), NASA and other US government research renters (Jet Propulsion Laboratory, Goddard Spaceflight Center, Ames Research Center, Johnson Space Center, Johns Hopkins Applied Physics Laboratory), Aerospace Companies (Lockheed Martin, Boeing, Ball, Orbital Sciences, Science Applications International Corporation), and private research centers (Southwest Research Institute, The Aerospace Corporation, Space Science Institute, Planetary Science Institute, Lunar and Planetary Institute).

Students that complete a Planetary Sciences Track Ph.D. at UCF will have the skills and training necessary to successfully compete for jobs and grants in this dynamic and exciting environment. The initial employment of a new Planetary Sciences Ph.D. usually is as a postdoctoral researcher under an experienced scientist at one of the listed institutions. Postdoctoral researchers in Planetary Sciences typically write proposals and win grant funding from NASA and NSF. It is not unusual for a Postdoctoral researcher to be fully self-supporting at the end of their postdoctoral period. They then move into Research Scientist or Professorial positions in any of the listed institutions.

Target audience and demonstrated need: Florida has a world-class space industry (Lockheed Martin, Boeing, United Space Alliance to name a few) and world-class space institutions (Kennedy Space Center, Air Force Eastern Test Range), as well as a growing, well-educations, and intensely space-interested population. These sources of students are increasingly demanding a world-class program in Planetary Sciences to support their career advancement and career plans. We have had intense interest and numerous inquires about a Planetary Science track at UCF from current undergraduates, employees of KSC and Lockheed Martin, and students from around the country and foreign countries. In addition, the Planetary Science Faculty of the Physics Department have over $2 million in NASA and NSF grant funding that can support Planetary Science graduate students.

Curriculum:

Ph.D. Requirements: A minimum of 72 credit hours beyond the bachelors degree or 42 hours beyond the masters degree. This includes completion of 6 core courses (18 hours) listed below, 5 electives (15 hours) selected in consultation with the students Supervisory Committee, a minimum of 15 hours of dissertation, and the remaining 24 hours of appropriately selected research, dissertation, and elective courses. Courses must be selected so that at least one-half of the 72 hours are at 6000 level or higher. No more than 12 hours of independent study may be credited toward the Ph.D. degree. The Ph.D. includes a Candidacy Exam to be taken after the completion of the core courses, a written dissertation, and a dissertation defense before the student's supervisory committee.

Ph.D. Core: The core is designed to give students a broad foundation in the planetary sciences and a rapid training in the data analysis techniques that will be necessary for a successful research and publications.

- **Statistical Physics (PHY 5524):** A study of physical concepts and methods appropriate for the description of systems involving many particles. Ensemble theory, partition functions. Maxwell Boltzmann, Bose-Einstein, Fermi-Dirac statistics.
- **Classical Mechanics (PHY 6246):** Variational principles. Lagrange, Hamiltonian, and Poisson bracket formulations of mechanics. Hamilton's principle of least action. Hamilton-Jacobi theory. Perturbation theory. Continuous systems. Chaos.
- **Either: Computational Physics (PHZ 5156):** Computational methods applied to the solution of problems in many branches of physics; or **Advanced Astronomical Data Analysis (AST 5937):** Advanced techniques for processing astronomical data including defringing, bootstrap and Markov-chain Monte Carlo analysis, advanced model fitting, wavelets, and numerical recipes.
- **Planetary Geophysics (New Graduate Course at the 5000 level):** The physics of planetary surfaces, surface processes, interiors, mineralogy, and reflectance spectroscopy.
- **Advanced Observational Astronomy (New Graduate Course at the 5000 level):** Design of scientific observing programs, acquiring astronomical data sets, applied astronomical data reduction, analysis of sources of observational error, publication of results.
- **Planetary Atmospheres (AST 5165):** The physics and chemistry that govern the behavior of the atmospheres of Earth and other planets including atmospheric dynamics, vertical chemistry, radiative transfer, gas spectroscopy, and cloud microphysics.

Suggested Electives for the Planetary Sciences Track:

- **Origins of Solar Systems (New Graduate Course at the 5000 level):** Formation of planetary systems beginning with the proto-stellar clouds, collapse, condensation, particle-disk interactions, accretion models, formation of satellites, what has been learned from observations of extra-solar planets, and the physics of magnetic fields generated by planetary bodies.
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- **Plasma Physics (PHZ 5505):** Introduction to theory and experimental basis of both weakly and highly ionized plasmas. Instabilities, plasma waves, nonlinear effects, controlled thermonuclear fusion.
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- **Quantum Mechanics I (PHY 5606):** Basic postulates of quantum mechanics, operators, eigenvalues, parity, potential wells, harmonic oscillator, time dependent and time independent Schrodinger equation, matrix formulation, and time independent perturbation theory.
- **Quantum Mechanics II (PHY 6624):** Time dependent perturbation theory, exchange symmetry, Dirac Equation, second quantization, and scattering theory
- **Introduction to Wave Optics (OSE 5041):** Electromagnetic foundation of light waves as applied to reflection, diffraction, interference, polarization, coherence, and guided waves.
- **Image Processing (EEL 5820):** Two-dimensional signal processing techniques; pictorial image representation; spatial filtering; image enhancement and encoding; segmentation and feature extraction; introduction to image understanding techniques
- **Fundamentals of Optical Science (OSE 5312):** Microscopic theory of absorption, dispersion, and refraction of materials; wave propagation, introduction to lasers and non-linear optics.

Admission: Students must be specifically admitted to the track. External applications and petitions to switch from the existing Physics Ph.D. program are considered by the Planetary Graduate Committee, to be appointed by the department Chair. This committee is to be chaired by a planetary scientist, will have one member from another research area in the department, and will have at least three members. Admission to the track requires a Bachelor of Science or equivalent, typically in physics, astronomy, geology, geophysics, geochemistry, atmospheric sciences, or planetary sciences. Those without full academic preparation in physics and astronomy, or low scores on the Departmental placement test may be required to complete specified coursework in addition to the core program, as determined by the Planetary Graduate Committee at the time of admission or their Supervisory Committee at a later date.

Supervisory Committee: Within the first half-semester, each student must select, by mutual agreement, a faculty advisor and two other faculty members to serve on his or her Supervisory Committee. One of the faculty members who is not the advisor must be from an area in the department other than planetary science. Changes in the membership of a Supervisory Committee must be approved by the Planetary Graduate Committee. The advisor is expected to meet regularly with the student. The full committee shall meet with the student at least once per semester to review and make recommendations regarding the student's academic progress. At the time of the Candidacy Exam, a non-UCF planetary scientist shall be added to the Supervisory

Committee. A self-funded department researcher who funds and supervises a student's dissertation research may petition the Planetary Graduate Committee to become a member of a student's Supervisory Committee, and to serve as the advisor after the student passes the Candidacy Exam.

Candidacy Exam: The astronomy track requires a Candidacy Exam to be taken after the completion of the core courses. This exam is composed of a written component and an oral exam. The written component is a journal-level research paper. The oral component is a two parts: (1) A public presentation of the research contained in the paper including the traditional question and answer period of a scientific presentation; and (2) private questioning on the detail of the presented research as well as the topics covered in the student’s preparation and course work. The written and oral components will be administrated by the student’s Supervisory Committee. A student must give the written examination paper to the Supervisory Committee 14 calendar days before the scheduled oral examination. Committee members are expected to read it and give a preliminary indication as to its acceptability four days thereafter. The preliminary indication of acceptability for a written examination paper is noncommital. Rather, it is intended to avoid obvious failures. By the start of the eighth day before the examination, the official version of the paper is due, and the Committee must decide whether to allow the oral examination to proceed. If the examination does not proceed, either due to decision of the Supervisory Committee or that of the student, the student is deemed not to have taken either part of the examination. Both the written and oral Candidacy examinations are deemed to take place at the time of the oral examination. Written results including comments on the paper are due within three days of the examination. The following outcomes are possible for either examination:

Pass
Pass conditioned on revisions (both) or additional coursework
Retake
Retake after additional coursework
Fail with option for Master's Degree
Fail without option for Master's Degree

Passes conditioned on revisions are handled as follows: all committee members sign the appropriate paperwork except the advisor. The advisor signs the paperwork when satisfied with the revisions. Students may only retake an examination once, and must do so within one year, or immediately after the next offering of a required course, whichever occurs later. If the student fails examination a second time or fails to retake the examination within the specified period, the student is dropped from the program.

Dissertation Proposal: The Dissertation Proposal may be presented simultaneously with the Candidacy Exam or in a separate meeting not more than one semester thereafter. Before substantial work is done on the dissertation, the Supervisory Committee must approve the proposal and must also assess whether additional coursework is necessary to begin the dissertation. Such coursework should be completed at the earliest opportunity and before substantial work is done on the dissertation.

Dissertation Defense: The Dissertation Defense is the final requirement for the PhD. It consists of a public presentation of the dissertation typically lasting 45-60 minutes including the traditional question and answer period of a scientific presentation, followed by private questioning by the Supervisory Committee. Procedures are similar to the Candidacy exam. A student must give the dissertation to his or her Supervisory Committee 14 calendar days before the scheduled defense. Committee members are expected to read it and give a preliminary indication as to its acceptability four days thereafter. The preliminary indication of acceptability for a written examination paper is noncommital. Rather, it is intended to avoid obvious failures. The student must then post notices of the presentation in a manner similar to that for a department colloquium. Written results including comments on the dissertation are due within three days of the defense. The following outcomes are possible:

Approval of the dissertation
Approval subject to revisions to be approved by the advisor
Required redefense

A redefense must occur within one year. At the second defense the redefense option is replaced by options for a Master's Degree or failure and removal from the program without a conferred degree.

Participating Faculty:

Professor H. Campins
Assistant Professor Y. Fernandez
Associate Professor D. Britt
Assistant Professor J. Harrington
Assistant Professor J. Colwell
Associate Professor E. Martin

Administration and Start Date: The program will be administered by a committee of Physics Department Planetary Science Faculty. Proposed start date for the track is August 20, 2008

Building the Program: There are currently few planetary graduate candidates. We propose to initially offer our courses as a mix of linked 4000/5000 level courses for advanced undergraduate and graduate students, and guided reading seminars for graduate students led by the planetary science faculty members. The 4000/5000 courses are linked to have sufficient numbers to support teaching the classes. For the core courses this involves three courses: (1) The proposed Advanced Observational Astronomy will be linked to the undergraduate Techniques of Observational Astronomy (the undergraduate course is requested to be upgraded from the current AST 3722 to the 4000-level). The proposed Planetary Geophysics course will be linked with undergraduate Planetary Geophysics (this course is currently AST 3110 Solar System Astronomy and is being requested to be upgraded to the 4000 level with a name change to Planetary Geophysics). Finally AST 5937 Astronomical Data Analysis is already linked with the undergraduate AST 4762 Astronomical Data Analysis course. The syllabi of the graduate and undergraduate versions of each course are attached for review. This short-term solution is consistent with the practice for previous successful planetary science graduate programs. The other core courses PHY 6246, PHY 5524, and AST 5165 are current stand-alone graduate courses.

Expected Number of Students: Over the first three years of the Planetary Science Ph.D program it is expected that 10 to 12 students will participate. Currently there are seven students in the physics department who will immediately transfer into the Planetary Science Ph.D. program once it becomes available.

Major Employers of Planetary Scientists

US Government Laboratories
- Jet Propulsion Laboratory
- Goddard Spaceflight Center
- Ames Research Center
- Johnson Space Center
- US Geological Survey
- The Smithsonian (Center for Planetary Sciences)
- Johns Hopkins Applied Physics Laboratory
- Los Alamos National Laboratory
- US Naval Observatory
- Lawrence Berkeley National Laboratory
- Marshall Spaceflight Center
- Glenn Research Center
- US Air Force Research Laboratory

Corporations
- Lockheed Martin
- Boeing
- Ball
- Orbital Sciences
- Science Applications International
- The Aerospace Corporation
- Raytheon
- General Dynamics
- Northrop Grumman
- Honeywell
- BAE Systems
- Malin Space Science Systems

Universities:
- University of Arizona (Lunar and Planetary Laboratory)
- University of Hawaii
- California Institute of Technology
- Washington University in St. Louis (McDonnell Center for the Space Sciences)
- University of Colorado (Laboratory for Atmospheric and Space Physics)
- Cornell University
- Arizona State University
- University of Texas
- Brown University
- University of California, Los Angles
- Massachusetts Institute of Technology
- University of California, Berkeley (Center for Integrative Planetary Sciences)
- University of Alaska

University of Virginia

Private Research Institutes

- Southwest Research Institute
- Space Science Institute
- The Carnegie Institution
- Planetary Science Institute
- Lunar and Planetary Institute
- Space Telescope Science Institute

SPLIT

ADVANCED

AST 5937: Astronomical Data Analysis

Fall 2007 Syllabus

Joseph Harrington

1 Course Vitals

Room: PL 101 (SCALE-UP classroom)

Lecture: TR 10:30 - 12:00

Grading: ABCDF w/ +-

Credits: 3(3,0)

Dates: 21 August - 29 November 2007

Final: project

Class URL: http://physics.ucf.edu/~jh/ast/ast5937/ast5937.html

Class directory: planets.physics.ucf.edu:/home/ast5937

Textbooks: Howell, S. B. 2000. *Handbook of CCD Astronomy*. Cambridge, ISBN 0-521-64834-3.
Bevington, P. R., and D. K. Robinson 2003. *Data Reduction and Error Analysis for the Physical Sciences*, 3rd Ed. McGraw Hill, ISBN 0-07-247277-8.
Oliphant, T. 2005. *Guide to NumPy*. At `http://tramy.us`

Press, W. H. *et al.* 1992. *Numerical Recipes in C*, 2nd Ed. Cambridge, ISBN 0-521-43108-5.

Prerequisites: (enrollment cap: 10 total for AST4932/5937)

MAC 2313 (calculus)

A 3000- or higher-level course in astronomy or permission of instructor

Job: Lecturer

Name: Joseph Harrington

Office: MAP 420

Phone: (407) 823-3416

Email: jh@physics.ucf.edu

Hours: TBD

2 Objectives

Those who successfully complete this course will be able to:

1. Understand basic statistics and error analysis as used in the physical sciences,
2. Extract physical measurements and error estimates from raw data,
3. Find, educate themselves about, and select appropriate numerical analysis methods, *
4. Fit a theoretical model to the measurements,
5. Draw scientifically-valid conclusions from the measurements,
6. Manage and carry out online work with large amounts of data, and
7. Present scientific results.

3 Approach

We cover the following topics in roughly this order:

1. Computers, programming, online management.
2. Introductory statistics and modeling.
3. Array detectors and corrections, image analysis.
4. Measurement extraction (example: stellar photometry).
5. Fitting.
6. Spectrographs and spectroscopy.
7. Project.

In addition, throughout the course, we will read about and discuss a series of advanced topics in computational data analysis.

4 Format

The class meets twice weekly in the computer trailer. Lecture attendance is mandatory. The weekly home work assignments are due Thursday at the beginning of class. **No late work will be accepted**, so PLAN AHEAD. Reading should be done **before** the class indicated: preparation for and participation in class discussion counts toward the final grade.

We use the SciPy Language. No experience is required, but students will need to become functional in SciPy within the first few weeks of the course.

Evaluation weighting:	
Homework	40%
Discussions	10%
Project results	25%
Project execution	15%
Project paper	10%

This is the graduate version of this class. It meets concurrently with the undergraduate version, but has additional assignments, a more challenging project, and additional readings on advanced topics in astronomical data analysis assigned during the semester, such as optimal photometric and spectral extraction, spectrum and time-series convolutions, interpolation methods, and wavelet analysis. Undergraduates with programming and data analysis experience may register for the graduate version, with permission of the instructor.

5 Grading

To encourage co-operation and group participation, grades will not be curved. It is possible for everyone to get an A. It is also possible for everyone to fail (but I hope not!). All reasonable questions regarding grading are welcome, but pure negotiation is not.

6 Academic Honesty, Sharing, and Information Sources

We will follow the letter and spirit of the UCF Golden Rule. Research in astronomy and physics relies on taking advantage of resources developed elsewhere: software libraries, descriptions of methods, etc. *Unless we state otherwise*, please use such external sources in your work. However, there are several conditions:

1. All math and text answers must be your original work. You may (and should) discuss the relevant general topics with each other, but you may not give specific help on or share assigned work.
2. For coding problems, the portion of the answer relevant to the problem must be your original work. For example, if the question asks you to subtract two images, you must write the code to do the subtraction but you may use third-party code to read the images from files.
3. You may not use the work of other students in the class, even if they wrote it long ago.
4. You must have legal permission to use an external source (assumed if publicly posted).
5. You **MUST** give credit to all external sources on a problem-by-problem basis. Credits must include the name of the item, a sentence fragment describing it if it is not obvious from the name, its author(s), year of authorship, and location (e.g., the name, volume, and pages of a journal article, or the URL of a

software package distributed online).

6. As with any scientific research project, you alone are responsible for the output: if you download a package that claims to do something and it has a bug that gives the wrong answer, the answer is wrong and you will be marked accordingly.
7. Work you did prior to the start of the course may not be handed in for grade (talk to the instructor for exceptions).

7 Working Effectively

There will be approximately weekly homework assignments and project work. It is critical that you do the homework and readings by the beginning of class on the due date, as we discuss answers in class. Your personal understanding is what counts in the discussions, and discussions count toward your final grade. Since answers will be discussed in class, **no late homework will be accepted**.

Compared to most physics courses, this course is heavy on skills, methods, and experience. These are taught with practice on real data in the homework assignments. You should budget significant time each week to work in the lab on your homework and project. You have priority access to the lab machines for the semester. Assignments will depend heavily on prior work done in the class, so skipping work is not very useful: you'll be doing the work anyway in order to do later assignments, so it makes sense to do it in time to get credit for it. Remember that debugging can take a long time, so start your assignments early! While time spent on the class varies a great deal according to students' prior programming experience, you should expect to spend an average of 6 10 hours per week outside of class on this course.

8 Homework Answer Format

All homework questions are **electronic assignments**, unless otherwise stated, including prose answers. Math (only) may be handed in handwritten on paper, if necessary, but we prefer electronic formats. Grammar, spelling, and complete sentences count for grade, including in answers that involve math (remember that "=" is a verb). **Math** problems must show your logic and calculations. **Box or circle** final math answers.

Use plain ASCII text files wherever possible, and certainly for all program text. Other allowed formats, in preference order: FITS (for data), PDF, PS, TeX/LaTeX, Excel, MSWord (the latter two only if they work in `ooffice`). You can convert MSWord to PDF by loading into `ooffice` and clicking "export PDF".

Handing in homework: Make a directory called `~/handin/hw3-jh`, substituting the right assignment number and your username. **Before class**, put the files you wish to hand in in that directory. We will copy all the assignment directories at the beginning of class automatically. **No late homework will be accepted, so be sure you actually *save* your files before class starts**! Do not email your homework.

For problems that do not specify the creation of new files, hand in a file of commands named, for example, `hw3-jh.py`. This should be a cleanly-coded, presentable file of commands, not a log file with other notes (note the name difference between this and a log file). In comments indicate your name, AST 5937, the assignment name, the date, and the problem numbers. We will be running these as batch files, so be sure to comment out any answers that are not commands. Also make sure all necessary program files are in the directory.

If the problem asks for a plot or image display, include commands for **both** on-screen display and output to a PostScript file. Include the files it makes in your directory. Plots should have titles and sensible axis labels, including units. Put each item in a separate file. The filenames should follow the format: `hw3-jh-prob2-plot1.ps`. *Only if requested,* put ASCII output to the screen (like tables) in files named like `hw8-jh-prob2-table1`. ASCII tables should have titles and column headers that distinguish them from one another and that make sense to the reader. You may hand-edit headers onto tables written by the computer.

9 Project and Advanced Readings

In October, each student will choose a final project based on real data. You will apply the methods learned in the course to produce a measurement and reach a scientific conclusion. There are several projects to choose from, or you may request permission to analyze some other data for which an analysis does not yet exist.

Three components of the project together contribute half of your final grade: a paper, which will follow the format of the *Astrophysical Journal*, what your coded analysis routines produce (results), and how well your analysis routines are coded and documented (execution).

The graduate project involves one additional component beyond the undergraduate project, namely the application of a numerical analysis method to the data. Possibilities here include without limitation Fourier or wavelet analysis, optimal extraction, Monte Carlo error estimation, or any of the other topics of the graduate readings.

In addition to the lecture schedule below, there will be ~10 weekly readings in numerical analysis from Press *et al.* and other sources in the first part of the course. Topics will include the following list, with additional readings determined in part by class interest and the needs of specific projects:

- Optimal photometric extraction (handout)
- Optimal spectrum extraction (Horne 1986, *PASP* **98**, 609-617)
- Monte Carlo error analysis (Press *et al.*)
- Robust estimation (Press *et al.*)
- Lomb-Scargle periodogram (Press *et al.*)
- Wavelet analysis (Torrence and Compo 1998, *BAMS* **79**, 61-78)

10 Fall 2007 Schedule

Reading and homework are due as assigned here. Lecture topics may not occur exactly on the day listed.

Date		Topic	Reading	Assignment
		Tools and Theory		
Aug 21	T	Introduction, computer accounts	Lab doc	
Aug 23	R	Unix/SciPy basics	Handout	HW1 (Unix)
Aug 28	T	SciPy graphics, image I/O	SciPy docs	
Aug 30	R	SciPy Programming, FITS data	Handout	HW2 (SciPy)
Sep 4	T	Measurement, Probability	Bev. Ch 1,2	
Sep 6	R	Error Analysis	Bev. Ch 3,4	HW3 (programming)
		Optical/Infrared Photometry		
Sep 11	T	Fitting	Bev. Ch 6	
Sep 13	R	Array Detectors		HW4 (stats)
Sep 18	T	Detector Systematics	How. Ch 1,2	
Sep 20	R	Infrared Arrays		HW5 (fitting)
Sep 25	T	Sky and Flat Field Frames	How. Ch 3-4.5	
Sep 27	R	Flat Fields, FITS, Interpolation		HW6 (S/N, 2D Gaussian)
Oct 2	T	Finding & Fixing Bad Pixels	How. Ch 4.6-5	
Oct 4	R	PSFs, Aperture Photometry		HW7 (dark & sky)
Oct 9	T	PSF-Fitting Photometry		
Oct 11	R	Atmospheric Absorption, Std. Stars	How. Ap C	HW8 (flat field, bad pixels)
		Optical Spectroscopy		
Oct 16	T	Introduction to Spectroscopy		
Oct 18	R	Spectrum Processing	How. Ch 6	HW9 (photometry)
Oct 23	T	Wavelength Calibration		
Oct 25	R	Line Profiles and Blends		HW10 (spectrographs)
Oct 30	T	Interrogating Spectral Lines		
		Project		
Nov 1	R	Time Series Analysis	Handout	HW11 (wavelength)
Nov 6	T	[Another DA example from physics]	Handout	
Nov 8	R	["]		(Project)
Nov 13	T	Fourier Transforms	Handout	
Nov 15	R	Fast Fourier Transform		(Project)
Nov 20	T	FFT in Practice	Handout	
Nov 22	R	Thanksgiving Day: no class		
Nov 27	T	Project presentations		(Project)
Nov 29	R	Project presentations		
Dec 5	W	(in exam period)		Final Project Due

AST 4932: Special Topics - Astronomical Data Analysis

Fall 2007 Syllabus
Joseph Harrington

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Job: Lecturer

Name: Joseph Harrington

Office: MAP 420

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Email: jh@physics.ucf.edu

Hours: TR 12 – 1

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Nov 20	T	FFT in Practice	Handout	
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Nov 29	R	Project presentations		
Dec 5	W	(in exam period)		Final Project Due

University of Central Florida

Course Action Request Form

☑ Course Addition ☐ Course Revision ☐ Course Deletion

Forward to your college office

Course Information NOTE: *Course additions and course revisions must be accompanied by a course syllabus and rationale.*
Note: Departments must also submit an electronic syllabus to the college curriculum person.

College: Sciences Department: Physics

Department Chair: Talat Rahman Phone: 407-823-5785

Academic Affairs Approved Instructor: Dr. Yan Fernández

	Course Prefix	Number	Title	Credit Hours Ex.: 3(3,0)
Course Prefix	AST	5xxx	Advanced Observational Astronomy	3(3,0)
New or Proposed Revision				

17 Char. Abbreviation: Adv Observ Astron

30 Char. Abbreviation: Adv Observational Astronomy

Course Description (25 word limit) (If course revision, underscore changes.):

Experimental design and experimental techniques in astrophysics; spherical astronomy; physics of telescopes and of common astronomical detectors; error analysis

Will lab fees be charged? ☐Yes ☑No Repeat for credit? ☐Yes ☑No How many times?

If course is repeatable, explain what will remain the same and what will change when the course is repeated.

If course is repeatable, who approves content before a course is repeated?

NOTE: *For a repeatable course, indicate in the syllabus what will remain the same and what will change when the course is repeated. Also indicate who approves content before a course is repeated.*

Prerequisite(s) and/or Corequisite(s): Graduate standing in the Physics department or in another department with C.I. Graded S/U? ☐Yes ☑No

Term of Offering
When will course be offered?

☐Odd Fall ☐Odd Spring ☐Odd Summer

☐Even Fall ☑Even Spring ☐Even Summer ☐Occasional

Justification for Course Addition or Course Revision

What is the rationale for adding/changing this course? It is a core class in the new Planetary Sciences track in the Physics Ph.D. program.

What majors require or recommend this course for graduation? Planetary Sciences track in Physics department.

If not a major requirement, what will be the source of students?

What is the estimated annual enrollment? 6 to 10

Possible duplications and conflicts with other departments or colleges should be discussed with appropriate parties. Please detail discussion you have had.

No duplications or conflicts.

University of Central Florida

Justification for Course Deletion

Is this course a required course for graduation in a major or prerequisite? ☐ Yes ☐ No

If yes, have the involved major departments been informed, in writing, of proposed deletion? ☐ Yes ☐ No

If not, explain:

Notes:

Approval Signatures

Department Chair		Date	3/28/08
College Academic Standards		Date	
College Dean		Date	4/11/08
Graduate Council		Date	
Academic Affairs		Date	

Sample Syllabus for AST 5xxx
Advanced Observational Astronomy
University of Central Florida

The Basics:

Instructor: Dr. Yan Fernández
Office: MAP 305D
Contact Info: Internet: yan@physics.ucf.edu
Telephone: 407-823-6939

Course Information:

Course rationale: While the field of Planetary Sciences makes use of physics, chemistry, and geology, a large fraction of all experiments are performed using remote-sensing telescopic data, as is the case in most of astronomy. This will be true well into the future since there are far more telescopes available (on the ground as well as in space) than there are spacecraft that can fly to Solar System objects. Thus, as in other fields, graduate students need to learn the concepts and practical aspects of experimental design and execution. In fact since the Planetary Sciences track in the Physics Ph.D. program will bring in students from a diverse undergraduate background, it is vital that they all understand how observations are planned and designed, and how high-quality data are acquired.

Course description: This is a graduate-level course intended to make students familiar with how to set-up and perform remote-sensing experiments in astronomy and astrophysics. Students will learn the principles and techniques used in planning and taking modern astronomical observations across all wavelengths of the electromagnetic spectrum. Students will learn the special problems and considerations necessary to successfully acquire good data from the bottom of Earth's atmosphere, from mid-air, and from space. The course will emphasize visible-wavelength imaging and spectroscopy since that is the most common wavelength regime, but other regimes will also be covered. Concepts in this course include: the celestial sphere, coordinate systems, time, star catalogs, telescopes, astronomical detectors, and the quantification of measuring light. Students will also make use of the telescopes at Robinson Observatory. Lectures in this course will be held concurrently with the undergraduate version of the course. [N.B.: We are petitioning to upgrade the current undergraduate version of the course, AST 3722C, to the 4000-level.] However the graduate course will be different in that (a) weekly readings will be more in-depth, more extensive, and from a much broader array of source material; (b) questions on homework assignments and exams will come from more diverse sources and require higher knowledge, more skills, greater independence of thought, and deeper application of concepts than those for the undergraduates; (c) students will be required to write a paper about original CCD observations they have planned, executed, recorded, and analyzed, and such observations must be performed with the 20-inch telescope at Robinson Observatory; and (d) the grading scheme will be different, where the graduate students will be held to a higher standard than the undergraduates.

Credit hours: 3 with 3 contact hours.

Course goals and objectives:

Goals: (1) Understand how the scientific method is used and how observationally-oriented science is done in astronomy. (2) Appreciate the observational challenges that have to be overcome in order to make an important contribution to astronomy. (3) Learn how technology has helped us address some of the fundamental problems in astronomy. (4) Learn what astronomical problems may be solved with future technology.

Objectives: (1) Understand how the Moon, the Sun, our latitude, and the time of year influence how we can make astronomical observations. (2) Comprehend the mechanics of working at a telescope and getting data. (3) Learn how raw digital imagery and spectroscopy of astronomical phenomena is converted into quantifiable data. (4) Understand the devices we use to detect radiation from across the electromagnetic spectrum. (5) Understand the current state-of-the-art in telescope design.

Course prerequisites: A B.S. degree in astronomy, physics, or related field; or approval of the instructor.

Course materials:

There is no required text, but weekly readings and homework will come from several books:

- *Astronomy: Principles and Practice*, 4th Edition, by A. E. Roy and D. Clarke.
- *Handbook of CCD Astronomy*, by S. B. Howell.
- *Interferometry and Synthesis in Radio Astronomy*, by A. R. Thompson, J. M. Moran, and G. W. Swenson.
- *The Fourier Transform and Its Applications*, 2nd Edition Revised, by R. N. Bracewell.

- *Astrophysical Techniques*, 4th Edition, by C. R. Kitchin.
- Books and journal articles as suggested by the instructor.

In addition there are some other items that will be useful:

- The book *Allen's Astrophysical Quantities*, 4th Edition, edited by A. N. Cox.
- A planisphere.

External course materials: Third parties may be selling class notes and other materials from this course without my authorization. Please be aware that such third-party materials may contain errors, which could affect a student's performance or grade. One can use these materials only at the student's own risk. On a related note, students can't sell my academic material. Please see section 11.A.1.d of the Golden Rule for specifics.

Expectations, Evaluations, Grading:

Course grade: A student's course grade is determined by how many points are earned during the semester. There is a total of 400 points that are earnable. Students can earn points in three ways: (1) exams, (2) homework, and (3) a paper. These items are described in more detail below. The correspondence of points to numerical grade and to letter grade will be as follows.

If a student earns at least this many points	student's course grade is
360	A
320	B
280	C
240	D
0	F

Examinations: There will be two exams. Each exam is worth 100 points toward a student's course grade. These exams will test knowledge of aspects of the course material and students' ability to apply that knowledge to new situations dealing with observational astronomy. The first exam will be a mid-term. The second exam will be a final exam that includes material from the entire semester, though with a distinct emphasis on the second half of the course.

Homework Assignments: A student can earn up to 100 points toward the course grade on these assignments. Some assignments will involve bookwork, some will involve actually observing. In the former case, homework problems will be assigned based on the readings. In the latter case, the assignments will involve either naked-eye observing or telescope observing. In particular it is important that every student gain experience using the 20-inch telescope at Robinson Observatory.

Paper: A student can earn up to 100 points toward the course grade by doing a research paper. The topic of the paper will preferably be a discussion of original research that has been undertaken by the student using Robinson Observatory. The observational aspects of the topic must be emphasized, as well as the data reduction that was necessary to lead to the result. Quantitative discussions are best. Also, it would be good practice for the paper's layout and form to adhere to the style guide for a major astronomical journal (e.g. ApJ, AJ, A&A). The student should talk with the instructor early on in the semester to discuss the topic that he/she would like to pursue. In special or unusual circumstances, observations from another observatory may be used, or an appropriate literature review may be used instead. The instructor must give consent for this, however.

Other Policies:

Missed work policy: It is the policy of the Department of Physics that making up missed work will only be permitted for University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (and in advance for University-sanctioned activities). At the discretion of the instructor, the make-up may take any reasonable and appropriate form including (but not limited to) the following: giving a replacement exam, replacing the missed work with the same score as a later exam, allowing a 'dropped' exam, replacing the missed work with the quiz average.

Golden Rule: Please read this information at the website `http://goldenrule.sdes.ucf.edu`.

UCF Creed: Please read this information at the website `http://www.ucf.edu/catalog/current/creed.htm`.

Disability access statement: As stated on the website `http://www.sds.ucf.edu/Faculty_Guide`, The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. No accommodations will be provided until the student has met with the professor to request accommodations. Students who need accommodations must be registered with Student Disability Services, Student Resource Center Room 132, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Collaboration policy: At the graduate-student level, it should be obvious that cheating would not only hurt one's grade in class but hurt one's ability to excel in a future career. The instructor encourages collaborating on homework assignments but exams should be done completely individually.

Schedule:

The following is a hypothetical schedule for this course. The instructor reserves the right to alter the sequence of topics and the topics that are actually covered.

Week	Topics
1	Celestial Sphere, Coordinate Systems
2	More Coordinate Systems, Time
3	Telescopes, Diffraction, Optics
4	Atmospheric and Topographic Effects on Light
5	Radiation, Optical Depth
6	Measuring Light through the Atmosphere, Photometry
7	CCDs
8	Adaptive Optics and Active Optics
9	Spectroscopy
10	Infrared Observations, Telescopes, and Detectors
11	High-Energy Observations, Telescopes, and Detectors
12	Radio Observations, Telescopes, and Detectors
13	Interferometry
14	Aperture Synthesis
15	Polarimetry

Sample Syllabus for AST 4xxx
Techniques of Observational Astronomy
University of Central Florida

The Basics:

Instructor:	Dr. Yan Fernández
Office:	MAP 305D
Contact Info:	Internet: `yan@physics.ucf.edu`
	Telephone: 407-823-6939

Course Information:

Course rationale: In astronomy, a large fraction of experimental methods require the use of remote-sensing telescopic data. Telescopes on the ground and in space will be crucial for answering fundamental questions about the origins of the Universe, our Galaxy, our Solar System, Earth, and life. This course will give students exposure to how observations are planned and designed, and how high-quality data are acquired. This course would replace AST 3722C at UCF.

Course description: This is an upper-division undergraduate-level course intended to make students familiar with how to set-up and perform remote-sensing experiments in astronomy and astrophysics. Students will learn the principles and techniques used in planning and taking modern astronomical observations across all wavelengths of the electromagnetic spectrum. Students will learn the special problems and considerations necessary to successfully acquire good data from the bottom of Earth's atmosphere, from mid-air, and from space. The course will emphasize visible-wavelength imaging and spectroscopy since that is the most common wavelength regime, but other regimes will also be covered. Concepts in this course include: the celestial sphere, coordinate systems, time, star catalogs, telescopes, astronomical detectors, and the quantification of measuring light. Students will also make use of the telescopes at Robinson Observatory. Lectures in this course will be held concurrently with the graduate version of the course [which we are currently petitioning to create]. However this undergraduate course will be different in that (a) homework assignments and exam questions will assume a lower standard of previous knowledge and the students will not be required to demonstrate as much independence of thought or as deep an application of concepts as compared to graduate students, (b) students will make use of the 8-inch telescopes at Robinson Observatory for eyepiece observations, and (c) the grading scheme will be different.

Credit hours: 3 with 3 contact hours.

Course goals and objectives:

Goals: (1) Understand how the scientific method is used and how observationally-oriented science is done in astronomy. (2) Appreciate the observational challenges that have to be overcome in order to make an important contribution to astronomy. (3) Learn how technology has helped us address some of the fundamental problems in astronomy. (4) Learn what astronomical problems may be solved with future technology.

Objectives: (1) Understand how the Moon, the Sun, our latitude, and the time of year influence how we can make astronomical observations. (2) Comprehend the mechanics of working at a telescope and getting data. (3) Learn how raw digital imagery and spectroscopy of astronomical phenomena is converted into quantifiable data. (4) Understand the devices we use to detect radiation from across the electromagnetic spectrum. (5) Understand the current state-of-the-art in telescope design.

Course prerequisites: AST 2002 and PHY 2048, or C.I.

Course materials:

The required text is *Astronomy: Principles and Practice*, 4th Edition, by A. E. Roy and D. Clarke. In addition a planisphere will be useful.

WWW: It is the student's responsibility to check the course website at least once a day for news. On the instructor's website one can download supplemental material, lecture info, and assignment info.

External course materials: Third parties may be selling class notes and other materials from this course without my authorization. Please be aware that such third-party materials may contain errors, which could affect a student's performance or grade. One can use these materials only at the student's own risk. On a related note, students can't sell my academic material. Please see section 11.A.1.d of the Golden Rule for specifics.

Expectations, Evaluations, Grading:

Attendance: This is mandatory. Exams will be based on material covered in class, even if some material is not in the textbook. Note that we will normally meet in room MAP 306 during classtime, but that certain class periods will take place at Robinson Observatory instead. I'll announce these ahead of time.

Reading Assignments: Before class, read the chapter(s) in the textbook that relate(s) to the upcoming lecture.

Course grade: The student's course grade is determined by how many points are earned during the semester. There is a total of 400 points that are earnable. One earns points in four ways: (1) exams, (2) homework, (3) observing participation, and (4) extra credit. Each way is described in more detail below. The correspondence of points to numerical grade and to letter grade will be as follows.

If you earn at least this many points	your course grade is
360	A
350	A-
330	B+
320	B
310	B-
290	C+
280	C
270	C-
250	D+
240	D
0	F

Homework Assignments: A student can earn up to 100 points toward the course grade on these assignments. Approximately every week, a small number of homework problems will be assigned. One should attempt to solve all of them, writing out each solution in a neat, easy-to-follow manner. Not all problems will necessarily be graded. The homework will be collected at the beginning of the class in which it is due. Late homeworks will be accepted but at significant grade penalty. If a student has trouble with the homework he/she should come to see the instructor well before the due date.

Examinations: There will be two exams. Each exam is worth 100 points toward the course grade. These exams will test knowledge of aspects of the course material and your ability to apply that knowledge to new situations dealing with observational astronomy. The first exam will be a mid-term. The second exam will be a final exam that includes material from the entire semester, though with a distinct emphasis on the second half of the course. You are not to collaborate with other people, but you can use external materials to solve the problems.

Observing: A student can earn up to 100 points toward the course grade by participating in observational labs. These labs will require either naked-eye observing or telescope observing. Robinson Observatory has several 8-inch telescopes that can be used to observe phenomena in the night sky. Note that one important thing each student will learn in this class is that experimental astronomy can be fraught with uncertainty – equipment may not work, schedules may change, and weather can be uncooperative.

Extra credit: Generally, the opportunities for extra credit will be limited. The instructor will announce details in class.

Other Policies:

Missed work policy: It is the policy of the Department of Physics that making up missed work will only be permitted for University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (and in advance for University-sanctioned activities). At the discretion of the instructor, the make-up may take any reasonable and appropriate form including (but not limited to) the following: giving a replacement exam, replacing the missed work with the same score as a later exam, allowing a 'dropped' exam, replacing the missed work with the quiz average.

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Collaboration policy: At the graduate-student level, it should be obvious that cheating would not only hurt one's grade in class but hurt one's ability to excel in a future career. The instructor encourages collaborating on homework assignments but exams should be done completely individually.

Schedule:

The following is a hypothetical schedule for this course. The instructor reserves the right to alter the sequence of topics and the topics that are actually covered.

Week	Topics
1	Celestial Sphere, Coordinate Systems
2	More Coordinate Systems, Time
3	Telescopes, Diffraction, Optics
4	Atmospheric and Topographic Effects on Light
5	Radiation, Optical Depth
6	Measuring Light through the Atmosphere, Photometry
7	CCDs
8	Adaptive Optics and Active Optics
9	Spectroscopy
10	Infrared Observations, Telescopes, and Detectors
11	High-Energy Observations, Telescopes, and Detectors
12	Radio Observations, Telescopes, and Detectors
13	Interferometry
14	Aperture Synthesis
15	Polarimetry

University of Central Florida

Course Action Request Form

☑ Course Addition ☐ Course Revision ☐ Course Deletion

Forward to your college office

Course Information NOTE: *Course additions and course revisions must be accompanied by a course syllabus and rationale.*
Note: Departments must also submit an electronic syllabus to the college curriculum person.

College: Sciences **Department:** Physics

Department Chair: Talat Rahman **Phone:** 407-823-5785

Academic Affairs Approved Instructor: Daniel Britt

	Course Prefix	Number	Title	Credit Hours Ex.: 3(3,0)
Course Prefix	AST	5XXX	Planetary Geophysics	3(3,0)
New or Proposed Revision				

17 Char. Abbreviation: Geophysics

30 Char. Abbreviation: Planetary Geophysics

Course Description (25 word limit) (If course revision, underscore changes.):

The physics of planetary evolution, planetary interiors, and planetary surface processes.

Will lab fees be charged? ☐ Yes ☑ No **Repeat for credit?** ☐ Yes ☑ No How many times?

If course is repeatable, explain what will remain the same and what will change when the course is repeated.

If course is repeatable, who approves content before a course is repeated?

NOTE: *For a repeatable course, indicate in the syllabus what will remain the same and what will change when the course is repeated. Also indicate who approves content before a course is repeated.*

Prerequisite(s) and/or Corequisite(s): Admission to Physics MS or PhD or CI **Graded S/U?** ☐ Yes ☑ No

Term of Offering
When will course be offered?

☐ Odd Fall ☐ Odd Spring ☐ Odd Summer

☑ Even Fall ☐ Even Spring ☐ Even Summer

Justification for Course Addition or Course Revision

What is the rationale for adding/changing this course? Needed for Planetary Science Physics Students. Covers a fundamental area of planetary sciences.

What majors require or recommend this course for graduation? Recommended for all Planetary Science Physics graduate students.

If not a major requirement, what will be the source of students?

What is the estimated annual enrollment? 6-10

Possible duplications and conflicts with other departments or colleges should be discussed with appropriate parties. Please detail discussion you have had.

University of Central Florida

Justification for Course Deletion

Is this course a required course for graduation in a major or prerequisite? ☐ Yes ☐ No

If yes, have the involved major departments been informed, in writing, of proposed deletion? ☐ Yes ☐ No

If not, explain:

Notes:

Approval Signatures

Department Chair	L. Rahman	Date	3/28/08
College Academic Standards		Date	
College Dean		Date	4/10/08
Graduate Council		Date	
Academic Affairs		Date	

Sample Syllaubs
Astronomy 5XXX
Planetary Geophysics

Course rationale: The field of planetary sciences encompasses a wide range of environments, surfaces and interiors of the planets and small bodies of our solar system. This diverse range of settings produces a range of physics and physical processes This course will study the physical processes and astrophysical context of planet formation and dynamical evolution in order to understand not only the history and evolution of our own planetary system but also the frequency and diversity of planetary systems throughout the galaxy,

Course description: An advanced course on the physics of the solar system. This will include an introduction to solar system mineralogy and petrology, the physics of magma crystallization and the geochemistry of liquid phases, the physics of planetary surface formation, heat sources and cooling, the physics of volcanism and tectonism, impact cratering, the physics of aeolian processes, the physics of aqueous processes, planetary hydrostatics, planetary gravity fields, seismology, interior structures of the planets, and the physics of planetary magnetospheres.

Course Prerequisites: Admission to the Planetary Sciences Track MS or PhD program, Physics MS or PhD program, or consent of the instructor.

Textbook: *Planetary Sciences*, Imke de Pater and Jack Lissauer. There is unfortunately no good book for Planetary Geophysics. All have glaring weaknesses that reflect the author's backgrounds (or lack thereof). We will supplement the book by readings of 10 review papers on topics covered in class.

Assignments and Grades: The basic requirements for this course are attending lectures, class discussion, reading the assigned chapters, exams, a research paper, and problem sets. You should read the assigned material that relates to the upcoming lecture before class.

Examinations: There will be two exams, a mid-term and a final. The final exam will be cumulative. Questions will be a mix of problems, short answers, and essays. The mid-tem will be 20% of the grade and the final will be worth 30% for a total of 50%. Examiation questions for graduate students

Problem Sets: I require that 10 problem sets be completed during the semester. The problem sets for graduate students will be advanced questions from the de Pater and Lissauer book and supplemented by essay questions I assign. Typically they will be handed out on a Wednesday and due the next Wednesday. The sets will be a combination of math and thought problems. The thought problems will require that you write short essays. Since I have had experience with the handwriting of students I am REQUIRING that any essay answers be typed. Problem sets account for a total of 25% of the grade.

Research Paper: The paper can be either a review of the relevant scientific literature on a particular topic or the discussion of original research that is relevant to planetary geophysics. The topics need to be approved by the instructor by week 3 of the course and papers need to adhere to the style of a major planetary science journal. The paper accounts for 25% of the grades.

Grading: Grades will be standard A-F with an A ≥ 90%, B ≥ 80%, C ≥ 70%, D ≥ 60%. I do not curve grades, but I do make adjustments for questions that turn out to be unusually hard or misleading.

Class Discussion: Asking/answering questions in class and discussing the assigned topic are also required. I will raise issues during every lecture and I expect EVERY student to participate in the discussion and ask questions. Being mute and passively listening to lecture is not an option.

Missed Work Policy: It is the policy of the Department of Physics that making up missed work will only be permitted for University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (and in advance for University-sanctioned activities). Given the appropriate documentation, make-up work will be set by discussion with the instructor.

Schedule:

Week 1: Introduction to solar system physics, physics of magma crystallization and the geochemistry of liquid phases

Week 2: Mineralogy and petrology, metamorphic minerals, mineral phase relationships

Week 3: Sedimentary minerals, ocean basins

Week 4 Planetary heat sources and cooling, cooling tectonics

Weak 5: Physics of volcanism and tectonism,

Week 6: Mountain building, hydrostatics

Weak 7 Impact cratering.

Week 8: Planetary Surface processes, erosion and deposition

Week 9: Aeolian processes

Week 10: Aqueous processes

Week 11: Glacial processes

Week 12: Climate and atmospheric heat flow

Week 13 Planetary interiors, gravity fields

Week 14 Seismology, interior structures of the planets,

Week 15: Physics of planetary magnetospheres

Astronomy 4XXX
Planetary Geophysics
University of Central Florida

Instructor: Dr. Dan Britt

Office: Math and Physics Building, 305B

Contact: Telephone, 407-823-2600; email, britt@physics.ucf.edu

Course description: An intermediate course on the nature and physics of the surfaces and interiors of solar system bodies. Prerequisites: Introductory astronomy (AST 2002) and College Physics I (PHY 2053). If you do not have this background you should find another class. I will assume that you have a basic understanding of the solar system (where is the Kuiper Belt?) and know classical mechanics (Newton, Kepler, etc). We have a lot of territory to cover, so I will not be spending any time re-doing basic astronomy.

Textbook: *Moons and Planets*, William K. Hartmann. There is unfortunately no good book for Planetary Astronomy. All have glaring weaknesses that reflect the author's backgrounds (or lack thereof). We will make do with a combination of the book, readings, and material from the lectures. Note that if you miss the lectures, you will miss that material.

Attendance is mandatory. **Exams will be based on the material covered in class, particularly if it is not in the book.**

* Assignments and Grades: The basic requirements for this course are attending lectures, class discussion, reading the assigned chapters, exams, and problem sets. You should read the assigned material that relates to the upcoming lecture before class.

> Examinations: There will be three exams, two in-class exams as listed in the attached schedule and a final. The final exam will be cumulative. Questions will be a mix of problems, short answers, and essays. Sorry, no multiple choice. The in-class exams will account for 20% of the grade each and the final will be worth 30% for a total of 70%.
>
> Problem Sets: I require that 10 problem sets be completed during the semester. Typically they will be handed out on a Wednesday and due the next Wednesday. The sets will be a combination of math and thought problems. The thought problems will require that you write short essays. Since I have had experience with the handwriting of students I am REQUIRING that any essay answers be typed. Problem sets account for a total of 30% of the grade.
>
> Grading: Grades will be standard A-F with an A $\geq$ 90%, B $\geq$ 80%, C $\geq$ 70%, D $\geq$ 60%. I do not curve grades, but I do make adjustments for questions that turn out to be unusually hard or misleading.

Class Discussion: Asking/answering questions in class and discussing the assigned topic are also required. I will raise issues during every lecture and I expect EVERY student to participate in the discussion and ask questions. Being mute and passively listening to lecture is not an option.

Missed Work Policy: It is the policy of the Department of Physics that making up missed work will only be permitted for University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (and in advance for University-sanctioned activities). Given the appropriate documentation, make-up work will be set by discussion with the instructor.

Schedule:

Week 1: Introduction to solar system physics, physics of magma crystallization and the geochemistry of liquid phases

Week 2:	Mineralogy and petrology, metamorphic minerals, mineral phase relationships
Week 3:	Sedimentary minerals, ocean basins
Week 4	Planetary heat sources and cooling, cooling tectonics
Weak 5:	Physics of volcanism and tectonism,
Week 6:	Mountain building, hydrostatics
Weak 7	Impact cratering.
Week 8:	Planetary Surface processes, erosion and deposition
Week 9:	Aeolian processes
Week 10:	Aqueous processes
Week 11:	Glacial processes
Week 12:	Climate and atmospheric heat flow
Week 13	Planetary interiors, gravity fields
Week 14	Seismology, interior structures of the planets,
Week 15:	Physics of planetary magnetospheres

Additions or Changes to Courses and Programs That Require Graduate Council Approval

Overview:

It is the responsibility of the Graduate Curriculum Committee of the Graduate Council to review new graduate courses and special topic requests, and recommend approval to the Vice Provost and Dean of the College of Graduate Studies on new tracks and certificates, and revisions to and deletions of existing graduate programs and courses. This committee must also approve changes to existing degree programs, such as the hours required, changes to core curriculum or significant changes to the curriculum, and the addition, deletion, or modification of an option, track, or specialty area.

Additions or changes requiring approval include:

1. **New graduate tracks and certificates**

2. **Changes to existing graduate programs, including:**
   a. Deletions and suspensions of existing graduate programs
   b. Program length
   c. Minimum number of hours needed to complete a program
   d. Revisions to the required core of the program
   e. Significant changes to the electives
   f. Adding new areas of specialization
   g. Revisions to courses taught outside the program
   h. Providing for online delivery of the program or delivery through continuing education
   i. For additional information on program development and program changes, please refer to the Faculty guide on the College of Graduate Studies website: http://www.admin.graduate.ucf.edu/sitemap/index.cfm?RsrcID=10

3. **New course actions and changes to existing courses, including: prerequisites, titles, hours, and course description.**
   - Course action and special topics request forms are available under the Duties of the Graduate Curriculum Committee section on the Graduate Council website: http://www.graduatecouncil.ucf.edu/Curriculum/

Reminder:

1. All requests for new courses must use the course prefix and the course level with "XXX" such as PSY 5XXX, PSY 6XXX, or PSY 7XXX.
2. The course prefix is not "owned" by a department or college; it corresponds to the discipline, and can be used by different departments/ colleges. Course numbers are assigned by Tallahassee.
3. Even if a course had a number in use by another SUS institution or had a number at one time at UCF, it should not be used on the course addition request form.
4. After Graduate Council action, course action requests are forwarded to the Academic Services Office for transmittal to Tallahassee for assignment of common course numbering.
5. Approved Special Topics requests are sent to course scheduling in the Registrar's Office so they may be made available for registration. (Special topics may be taught two times before a new request should be submitted.)
6. For additional information on course development, please refer to the Faculty guide on the College of Graduate Studies website: http://www.admin.graduate.ucf.edu/sitemap/index.cfm?RsrcID=10

New Items:

- *All CARS must include the course offering (required or elective).*
- *All CARs must include the term of offering for the course.*
- *All CARs and STs must include the name of an Academic Affairs Approved Instructor.*
- *For repeatable courses, the CAR must include the number of times a course can be repeated, and the syllabus should include what remains the same, what parts will change, and who approves content before a course is repeated.*

All additions and revisions to programs and courses should be discussed with programs/ colleges who have courses and program offerings in similar content areas. Include approval documentation from the other programs/colleges.

All requests being sent to Graduate Council must have all necessary program and college approval signatures. Requests should be forwarded through your college to UCF College of Graduate Studies.

Graduate Curriculum Committee
Course Agenda 09-17-08

College of Arts & Humanities Course Action Additions

Tabled
DIG 6XXX CAH-Digital Media 3(3,0)
Theory & Application of Interactive Performance: PR: SFDM MFA or MA, or C.I. Study of theory and application of concepts for interactive digital media design using scenario construction, character development, and technology. May be used in the degree program a maximum of 5 times only when course content is different.
30 character abbreviation: **Theory & App Interact Perf**
AGENDA NOTES: Special Topic also being proposed.

Tabled
ENG 5XXX CAH-English 3(3,0)
Contemporary Movements in Literary, Cultural, and Textual Theory: PR: Graduate Standing in English or C.I. Theories of literature, cultural, and textual formation since the mid-20th century.
30 character abbreviation: **Cont Movements LCT Theory**

Tabled
ENG 5XXX CAH-English 3(3,0)
Historical Movements in Literary, Cultural, and Textual Theory: PR: Graduate Standing in English or C.I. Theories of literature, cultural, and textual formation from ancient Greece to the mid-20th century.
30 character abbreviation: **Historical Movement LCT Theory**

Tabled
ENG 6XXX CAH-English 3(3,0)
Studies in Literary, Cultural, and Textual Theory: PR: Graduate Standing in English or C.I. Specific topics in the study of literature emphasizing cultural and theoretical issues. May be used in the degree program a maximum of 2 times only when course content is different.
30 character abbreviation: **Studies in LCT Theory**

Tabled
LIT 5XXX CAH-English 3(3,0)
Teaching College Literature: PR: Graduate standing in English or C.I. Pedagogical theory and practical techniques for teaching literature in college and university settings.
30 character abbreviation: **Teaching College Literature**

Tabled
LIT 6XXX CAH-English 3(3,0)
Capstone Course: PR: At least 18 graduate credit hours in English. Systematic and comprehensive revision of previous graduate writing with special attention to use of theory and professionalization toward the goal of publication and/or conference presentation.
30 character abbreviation: **Capstone Course**

Tabled
LIT 6XXX CAH-English 3(3,0)

Issues in Literary Study: PR: Graduate Standing in English or C.I. Specific issues and controversies in literature study. May be used in the degree program a maximum of 2 times only when course content is different.
30 character abbreviation: **Issues in Literary Study**

College of Sciences Course Action Additions

AST 5XXX COS-Physics 3(3,0)
Advanced Observational Astronomy: PR: Graduate standing in the Physics department or in another department with CI. Experimental design and experimental techniques in astrophysics; spherical astronomy; physics of telescopes and of common astronomical detectors; error analysis.
30 character abbreviation: **Adv Observational Astronomy___**

AST 5XXX COS-Physics 3(3,0)
Planetary Geophysics: PR: Admission to Physics MS or PhD or CI. The physics of planetary evolution, planetary interiors, and planetary surface processes.
30 character abbreviation: **Planetary Geophysics**

PHY 6XXXC COS-Physics 3(2,2)
Theory and Computations of Molecular Wavefunctions: PR: Undergraduate Quantum Mechanics or Physical Chemistry or C.I. Approximate method of solving electronic Schrodinger equation for molecular systems: Hartree-Fock and semiempirical methods, basis sets, multireference wavefunction theory methods, potential surfaces, electronic transitions.
30 character abbreviation: **Molecular Wavefunction Theory_**
AGENDA NOTES: Special Topic also being proposed.

Engineering & Computer Science Course Action Additions

Tabled
COP 6XXX ECS-Computer Science 3(3,0)
Network Optimization: PR: Graduate standing. Recent advances in theory and computational techniques for optimal design and analysis of large networks for computers communications, and transportation including Internet and WWW complex networks
30 character abbreviation: **Network Optimization**

Engineering & Computer Science Course Action Revisions

Tabled
COP 5537 Network Optimization 3(3,0)
PR: Graduate Standing or C.I.
~~Recent advances in the theory and computational techniques for optimal design and analysis of large networks for computers, communications, transportation, web and other applications.~~
Techniques for modeling complex, interconnected systems as networks; optimization with graph theory; algorithms, data structures, and computational complexity; statistical methods for studying large, evolving networks.