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GLASSBORO STATE COLLEGE

Department of Physical Science

Paul F. Dike, Chairman

- I. Course Proposal - Methods and Techniques in Observational Astronomy
- II. Course Proposal Sponsors: W. C. Woods Jr. and Donald A. Farnelli
- III.. Department Chairman's Statement

- A. Since it is essential for the astronomy student to have a direct experience in the practical aspects of observational astronomy, this proposal is directed toward meeting this need.
- B. Our students have long requested this type of course as a requisite to the complete understanding of astronomy.
- C. With the recent aquisition of astronomical equipment we are now in a position to offer this program as an enhance-ment of our present course, Introductory Astronomy 1911.310.
- D. I recommend this course proposal for your consideration and adoption.

IV. Position of Course in Department: (Objectives)

- A. Astronomy 1911.310 is currently offered by the Department of Physical Science as an introductory course. It is a free elective to any student as well as basic to an Earth Science concentration. The proposed undergraduate course will extend vital aspects of Astronomy to that level where practical application of course work will have greater depth. Due to the nature of Astronomy, it is inherent that direct observation be a part of its instruction. Over the past seven years we have acquired the necessary observational equipment to make such a program vital and relevant. Astronomy 1911.310 provides only a minimum opportunity for observation of planetary and stellar objects. Methods and Techniques in Observational Astronomy is de-signed to make maximum use of equipment as well as provide continued observation and application of astronomical measurements in the laboratory situation..
- B. Methods and Techniques of Observational Astronomy (1911.311) would be offered each semester during the evening hours. The prerequisites for this course of study would be the successful completion of or concurrently taking Astronomy 1911.310. The first offering of the course would be during the Fall semester 1974. The preferred time for the presentation of this course would be between 8 and 11 P.M. Course credit - 3 S.H.

- C. Methods and Techniques in Observational Astronomy (1911.311) will be taught by qualified staff who are presently teaching in the area of Astronomy and Physics. The present resources of the college are adequate for the presentation of this course. A library of texts and periodicals presently exist within the department to service the needs of the student. Telescopes and optical equipment are available for use in the program.
- D. Astronomy involves not only the basic introductions to cosmology and cosmogony, but also direct observation of the nature of the universe. This can be done only through prolonged observation and dedication as evidenced by the work of astronomers. As one relates the dedicated and time-consuming observations of a trained microscopist to the success of his understanding of the microcosm, likewise one must relate also the same understanding to the work of the optical astronomer and the macrocosm. It is without doubt, a necessary function in order to have a full and concerted understanding of the field. We have at our fingertips the students, equipment and staff necessary to make such a course offering a success.

V. Details of Proposal (Course Description)

- A. This course will extend the present Astronomy (1911.310) as given to students as indicated in Item D, Section IV.
- B. Students will be given a first-hand experience in the techniques and use of optical equipment used in astronomy, as well as the practical application of such equipment. This equipment utilization and optical observation will relate to the electromagnetic spectrum within the limits of visible light and the aspects of this energy in its application to astronomy.
- C. The course content will cover the following:
 - 1. The Tools of the Astronomer
 - a. The Optical Telescope, its structure and function; the types of optical telescopes and their historical development; optics of the telescope and the determination of structure and function in the telescope: refractors vs. reflectors.
 - b. The Spectroscope, its structure and function in the study and analysis of stellar and planetary atmospheres; the use of the spectroscope in conjunction with optical telescopes; historical development of the spectroscope and its place in astronomy.
 - c. The Radio Telescope, its structure and function; the radio window in space and its importance to optical astronomy; applications of radio interferometry and the study of stellar, planetary and galactic sources.
 - 2. Observational Activities
 - a. Continuous observation of planetary, stellar and galactic objects; analysis of stellar, planetary

- galactic and satellite motion.
- b. Use of sextant, astrolabe and quadrant in determination of celestial position.
 - c. Observation of multiple star systems; binary stars, pulsating variables, eclipsing binaries, novae, etc., to determine the cyclic nature of stars as well as the importance of them as measuring sticks in the universe.. . among the most important are Cepheids and RR Lyare Variables.
 - d. Celestial and Galactic coordinate systems and their determination; structural relationships of systems relative to the time/space continuum; plotting relative positions of celestial events and objects.
 - e. Spectroscopic observations of planetary and stellar atmospheres; doppler shift analysis of spectra.
 - f. Astro-photography of both planetary and stellar objects; events of eclipses; satellite and meteor trails; techniques of astro-photography.
3. Cosmology and Cosmogony
- a. Big Bang and Steady State Theories; Oscillating Universe Theory; Hubble's Law; Current Theories in Cosmological Evolution; Galactic Evolution; Quasars; Pulsars; X-Ray Sources; Infrared Sources; Blackholes.

VI. Rationale:

- A. There is little direct application of astronomy in the observational sense. To talk about the objects of the night sky is a far removed fact from direct observation.
- B. Methods and Techniques in Observational Astronomy will utilize to the fullest potential the facilities of the Physical Science Department's Astronomy equipment and personnel as well as provide first hand experience for the students, a hands on experience!
- C. Methods and Techniques in Observational Astronomy will be an extension of existing coursework which will enhance the environmental awareness competencies of our students. Furthermore, we have the facility to provide for such an enhancement.
- D. Students have strongly requested the availability of such a course for their intended use. A log of participants having used our facilities in the past is available. The Observatory Log (Olen M. Self Observatory, Bosshart Observation Roof) has been in existence since March of 1967. Note: This log is a complete resume of the numbers in attendance and the time of each observation. This time was given voluntarily by both student and faculty participants.
- E. Methods and Techniques in Observational Astronomy will provide needed time for fundamental observation and research for both students and faculty. We have a 12.5-inch reflector available for just such observational research.

- F. The time line for this course (8:00 to 11:00 P.M.) will provide additional motivation for students already having completed the course Astronomy (1911.310) to continue their participation in the already popular area of astronomy. They will also contribute to the observational data now underway in this area.

VII. Course Outline

A. Methods of Optical Astronomy

1. Optical Systems in Telescopes
 - a. Refracting and Limitations
 - b. Reflecting and Limitations
2. Nature of Light in Optical Systems
 - a. Velocity of Light
 - b. Wave Nature of Light
 - c. Quantum Theory of Light
 - d. Polarization of Light
 - e. Diffraction of Light
 - f. Interference and Diffraction
 - g. Spectroscopic Analysis
 - h. Optical Filter Systems
3. Solar Studies
 - a. Spectroheliograph
 - b. Coronagraph
 - c. Interferometer
4. Schmidt Camera
 - a. Use in Astrophotography
5. Properties of an Image
 - a. Lens Images, Virtual and Real
 - b. Telescopic quality
6. Magnification and Resolution in Systems
 - a. Focal length
 - b. Focal Ratio
 - c. Optical Deficiencies in Systems

B. Celestial and Galactic Position

1. Horizon System
 - a. Altitude/Azimuth
2. Equatorial System
 - a. Right Ascension
 - b. Declination
3. Galactic Coordinates
 - a. Equator
 - b. Poles
 - c. Longitude

4. Using the Celestial Sphere
 - a. Right Ascension/Declination
 - b. Hour Angle
 - d. Sidereal Time
- C. Classification of Celestial Objects
 1. Galaxy and Radio Sources
 - a. Messier
 - b. Herschel
 - c. Dreyer
 2. Star Classification and Spectra
 - a. Bayer
 - b. Argelander
 - c. Draper
 - d. Flamsteed
 3. Catalogs of Radio Sources
 - a. 3d Cambridge Catalog
 - b. UV Sources - Smithsonian
 - c. Cal Tech - Infrared Survey
 - d. NASA - X-Ray sources
- D. Cosmological Theories
 1. Big Bang - Gamow
 2. Steady State - Hoyle
 3. Black Holes
- E. Evolution of Exterrestrial Life
 1. Drake
 2. Struve
 3. Bracewell
 4. Sagan
 5. Montagu
 6. Van de Kamp
 7. Dyson
- F. Astro-Photography
 1. Procedures for Taking Photographs
 - a. Types of Camera Systems
 - b. Types of Film and Exposure procedures
 - c. Optical Systems and Stability
 2. Types of Films to Use
 - a. Stellar Photography
 - b. Solar Photography
 - c. Spectral Analysis
 - d. Polaroid Systems
 3. Optical Filters and Their Use
 - a. Neutral Density Filters
 - b. Function of Filters in Astro-photography
 - c. Types best used for Photography in 2a & 2b

- 4. Procedures for Printing and Developing
 - a. Dark Room Procedures
 - b. Enlarging
- G. Special Optical Studies (Project observational studies)
 - 1. Distant Sky Objects
 - a. Galactic and Radio Sources
 - b. Star Fields
 - (1) classifying and analysis
 - c. Visual and Spectroscopic Binaries
 - d. Multiple stellar systems
 - e. Pulsating Variables(Cepheids/RR Ly

NOTE: Items A through G are designed for student observation and verification using directed laboratory techniques under the supervision of the instructor. Lecture time will be given to these subjects during nights when the sky is obscured making observation impossible. Practical application and utilization of equipment will be the primary objectives of Methods and Techniques in Observational Astronomy 1911.311.

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