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*The Ultimate Advantage is an Educated Mind*

**SYLLABUS: SPST633 – Astronomical Instrumentation**

(3 credit hours) (8 Week Session) (No Prerequisites)



**INSTRUCTOR INFORMATION**

**Office Hours:**

**COURSE DESCRIPTION (CATALOG)**

**SPST633 Astronomical Instrumentation (3 Hours)**

This course examines the design and construction of astronomical instruments, including mechanical design and machining, optics and commensurate optical system design, and both real-time and near-real time computer control. UV, X-ray, and gamma-ray spectrum instrumentation will also be addressed.

**COURSE SCOPE**

An overview of the development, design, and usage of astronomical instrumentation – with emphasis on telescopes – is considered within the scope of this course. The evolution of telescopic optical designs over the course of history will be integrated in the curriculum. Students will learn about the various types of instruments used for studying light across the electromagnetic spectrum. Methods of processing light, including active and adaptive optics, will be considered. Participants will have an opportunity to learn about the most significant ground / space-born observatories.

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## COURSE OBJECTIVES

Upon completion of this course, the student will be able to:

- Appreciate the historical development of astronomical instrumentation.
- Differentiate between the different basic optical designs.
- Describe issues that may affect telescope optical quality.
- Discuss the various methods of analyzing light (e.g., spectroscopy and photometry).
- List the major astronomical observatories across the globe and in space.
- Understand advanced telescopic techniques such as active and adaptive optics.
- Discuss astronomical instrumentation for use across the electromagnetic spectrum.
- Recite “cutting-edge” discoveries made via astronomical instrumentation.
- Elaborate on the future development of telescopes and associated instrumentation.

## COURSE DELIVERY METHOD

SPST633 is delivered to you via the online Sakai Learning Management System (LMS). Distance learning will enable students to complete academic work in a flexible manner, completely online.

## COURSE MATERIALS

### Course Textbook:

Andersen, Geoff, 2007, “The Telescope: Its History, Technology, and Future,” Princeton University Press, 248 p.

### Additional Reading:

Announcements, forums, online lessons, and selected journal articles

### Websites:

In addition to the required course texts, the following public domain websites are useful. Please abide by the university’s academic honesty policy when using Internet sources as well. Note Web site addresses are subject to change.

| Site Name                 | Website URL/Address   |
|---------------------------|---|
| Hubble Space Telescope    | <a href="http://www.nasa.gov/mission_pages/hubble/main/index.html">http://www.nasa.gov/mission_pages/hubble/main/index.html</a>                               |
| Spitzer Space Telescope   | <a href="http://www.nasa.gov/mission_pages/spitzer/main/index.html">http://www.nasa.gov/mission_pages/spitzer/main/index.html</a>                             |
| Arecibo radio Observatory | <a href="http://www.naic.edu/general/">http://www.naic.edu/general/</a>   |
| Observatories in Space    | <a href="http://imagine.gsfc.nasa.gov/docs/introduction/space_observatories.html">http://imagine.gsfc.nasa.gov/docs/introduction/space_observatories.html</a> |

### Other Resources:

As provided

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## EVALUATION PROCEDURES

Your final grade will consist of an average of the following items:

**Forum Participation:** Eight times throughout this course discussion items will be posted within the Forum area of the classroom. Your responses must be between 100-300 words, be in YOUR OWN WORDS, well written and grammatically correct. Sources used must be cited at the end of your posting (not included in the word count). Your responses will clearly show whether you have completed assigned classroom readings. Opinions are always welcome... However, postings providing only opinions will be graded accordingly! Be sure to read the directions associated with each posting.

**Weekly Quizzes:** Quizzes are designed to review assigned reading or video assignments. Quizzes are to be taken online, and you will get two attempts at each quiz to help you master the material. The highest score of the two attempts is the one that is kept. Quizzes must be taken during specific dates. Although open book, students are not to give or receive help on the weekly quizzes.

**Homework Assignments:** There are eight homework assignments for this course, each covering various aspects of assigned course readings. Information on homework assignments will be posted within the Assignments area of the classroom, on the days listed in the Announcements (home) page.

Your efforts in this course will be evaluated based upon the following:

| Assignments                                      | % of Grade |
|--|------------|
| Forum Postings (8 total – 50 points each)        | 400        |
| Weekly Quizzes (8 total – 50 points each)        | 400        |
| Homework Assignments ( 8 total – 75 points each) | 600        |

**Total 1400 pts**

**GRADING SCALE:** Please see the [Student Handbook](#) to review the University's grading scale.



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RECOMMEND PRINTING THE NEXT PAGE AND KEEP IT HANDY...

**COURSE OUTLINE**

| Week | Topics & Learning Objectives   | Readings/Assignments   |
|------|--|--|
| 1    | <p><b><i>History of Astronomical Instrumentation</i></b></p> <ul style="list-style-type: none"> <li>• Naked Eye Astronomy</li> <li>• Lippershey, Galileo, &amp; Newton</li> <li>• Herschel, Parsons, &amp; Hale</li> <li>• Electromagnetic Spectrum</li> </ul>   | <p>Andersen: Chapters 1 &amp; 2</p> <p>Week 1 Agenda found within "Announcement" Section</p> |
| 2    | <p><b><i>Telescope Primer – Basic Optical Designs</i></b></p> <ul style="list-style-type: none"> <li>• Optics Primer</li> <li>• Refracting &amp; Reflecting Telescope</li> <li>• Other Optical Telescope Designs</li> <li>• Visible Wavelengths – Hubble Space Telescope</li> </ul>                                | <p>Andersen: Chapter 3</p> <p>Week 2 Agenda found within "Announcement" Section</p>          |
| 3    | <p><b><i>Image Quality &amp; Degradation</i></b></p> <ul style="list-style-type: none"> <li>• Diffraction &amp; Image Quality</li> <li>• Resolution Limit</li> <li>• Chromatic and Spherical Aberrations &amp; Coma</li> <li>• Air Turbulence</li> <li>• Infrared Wavelengths – Spitzer Space Telescope</li> </ul> | <p>Andersen: Chapters 4 &amp; 5</p> <p>Week 3 Agenda found within "Announcement" Section</p> |
| 4    | <p><b><i>Methods of Analyzing Light</i></b></p> <ul style="list-style-type: none"> <li>• CCD Imaging</li> <li>• Spectroscopy</li> <li>• Photometry &amp; Interferometry</li> <li>• Microwave Wavelengths – Planck Microwave Space Observatory</li> </ul>   | <p>Andersen: Chapters 6 &amp; 7</p> <p>Week 4 Agenda found within "Announcement" Section</p> |
| 5    | <p><b><i>Great Observatories</i></b></p> <ul style="list-style-type: none"> <li>• Site Selection</li> <li>• Telescope Mounts</li> <li>• Great Refractors Telescopes (Yebes)</li> <li>• Great Reflecting Telescopes (Hale &amp; Keck)</li> <li>• Radio Wavelengths – Arecibo Radio Observatory</li> </ul>           | <p>Andersen: Chapters 8 &amp; 9</p> <p>Week 5 Agenda found within "Announcement" Section</p> |
| 6    | <p><b><i>Advanced Telescope Techniques</i></b></p> <ul style="list-style-type: none"> <li>• Active Optics</li> <li>• Segmented Mirrors</li> <li>• Adaptive Optics &amp; Laser Guide Stars</li> <li>• UV Wavelengths – World Space Observatory</li> </ul>   | <p>Andersen: Chapter 10</p> <p>Week 6 Agenda found within "Announcement" Section</p>         |
| 7    | <p><b><i>Exploring the Electromagnetic Spectrum</i></b></p> <ul style="list-style-type: none"> <li>• Radio Waves, IR, &amp; UV Waves</li> <li>• X-Rays &amp; Gamma Rays</li> <li>• Gravitational Waves</li> <li>• X-Rays – Chandra X-Ray Observatory</li> </ul>  | <p>Andersen: Chapter 13</p> <p>Week 7 Agenda found within "Announcement" Section</p>         |

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|   |  |  |
|---|--|--|
| 8 | <b><i>Future of Astronomical Instrumentation</i></b> <ul style="list-style-type: none"><li>• Great Discoveries</li><li>• Wide Field Telescopes</li><li>• Terrestrial Planet Finder</li><li>• Giant Telescopes</li><li>• Gamma Rays – Fermi Gamma Ray Observatory</li></ul> | Andersen: Chapters 14 & 15<br>Week 8 Agenda found within<br>“Announcement” Section |
|---|--|--|

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**POLICIES:** Please see the [Student Handbook](#) to review University policies regarding Drops/Withdrawals, Plagiarism, Extensions, and Disability Accommodations.

## WRITING EXPECTATIONS

All written submissions should be submitted in a font and page set-up that is readable and neat. It is recommended that students try to adhere to a consistent format, which is described below.

- Typewritten in double-spaced format with a readable style and font and submitted inside the electronic classroom (unless classroom access is not possible and other arrangements have been approved by the professor).
- Arial 11 or 12-point font or Times New Roman styles.
- Page margins Top, Bottom, Left Side and Right Side = 1 inch, with reasonable accommodation being made for special situations and online submission variances.

## CITATION AND REFERENCE STYLE

Assignments completed in a narrative essay or composition format must follow Turabian Citation Style guidelines. This course will require students to use the citation and reference style established by Kate Turabian in her *A Manual for Writers of Term Papers, Theses, and Dissertations*, 6th edition, 1996.

## LATE ASSIGNMENTS

For each day that an assignment is late, 10% may be deducted from your grade for the assignment unless the student contacts the instructor ahead of time about an extenuating situation.

## NETIQUETTE

Online universities promote the advance of knowledge through positive and constructive debate--both inside and outside the classroom. Discussions on the Internet, however, can occasionally degenerate into needless insults and "flaming." Such activity and the loss of good manners are not acceptable in a university setting--basic academic rules of good behavior and proper "Netiquette" must persist. Remember that you are in a place for the fun and excitement of learning that does not include descent to personal attacks, or student attempts to stifle the discussion of others.

- **Technology Limitations:** While you should feel free to explore the full-range of creative composition in your formal papers, keep e-mail layouts simple. The Educator classroom may not fully support MIME or HTML encoded messages, which means that bold face, italics, underlining, and a variety of color-coding or other visual effects will not translate in your e-mail messages.
- **Humor Note:** Despite the best of intentions, jokes and--especially--satire can easily get lost or taken seriously. If you feel the need for humor, you may wish to add "emoticons" to help alert your readers: ;-), :), ☺





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## ACADEMIC SERVICES

### ONLINE LIBRARY RESEARCH CENTER & LEARNING RESOURCES

The Online Library Resource Center is available to enrolled students and faculty from inside the electronic campus. This is your starting point for access to online books, subscription periodicals, and Web resources that are designed to support your classes and generally not available through search engines on the open Web. In addition, the Center provides access to special learning resources, which the University has contracted to assist with your studies. Questions can be directed to [orc@apus.edu](mailto:orc@apus.edu).

- **Charles Town Library and Inter Library Loan:** The University maintains a special library with a limited number of supporting volumes, collection of our professors' publication, and services to search and borrow research books and articles from other libraries.
- **Electronic Books:** You can use the online library to uncover and download over 50,000 titles, which have been scanned and made available in electronic format.
- **Electronic Journals:** The University provides access to over 12,000 journals, which are available in electronic form and only through limited subscription services.
- **Turnitin.com:** a web-based plagiarism prevention application licensed for campus use through the APUS Online Library. All students should sign up for an APUS student profile. With an APUS student profile, students can submit class assignments, as directed by instructors. Students also can use Turnitin outside of enrolled courses, as a learning tool, uploading and checking their work to avoid instances of inadvertent plagiarism.
- **Smarthinking:** Students have access to 10 free hours of tutoring service per year through [Smarthinking](#). Tutoring is available in the following subjects: math (basic math through advanced calculus), science (biology, chemistry, and physics), accounting, statistics, economics, Spanish, writing, grammar, and more. Additional information is located in the Online Research Center. From the ORC home page, click on either the "Writing Center" or "Tutoring Center" and then click "Smarthinking." All login information is available.



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Course content may vary from the outline to meet the needs of this particular group.