SYLLABUS
GENERAL ASTRONOMY - PHYS 1700 80 - CRN 40510

JASON KENDALL, WILLIAM PATERSON UNIVERSITY

1. The Most Challenging Class You'll Ever Love.

The science of astronomy is without a doubt the most interesting and fascinating thing you'll ever work on. We will deal with the origin of the Earth, the Sun and the Universe. We'll learn the names of stars, and how to find them in the sky. We'll learn about ancient oceans on Mars and planets around other stars. We'll glimpse the madness of the surface of a neutron star, where you would weigh as much as a mountain if you stood on it. We'll witness the gossamer beauty of interstellar clouds, which are the birthplace of stars. We'll dive into a black hole where space and time crush together into a maelstrom of destruction. We'll learn what a shooting star is, and how you can find them. We'll see distant galaxies, all homes to billions of stars and countless planets. We'll tour Saturn's rings, and Jupiter's Great Red Spot. We'll even take a trip with a spacecraft all the way out to distant Pluto.

In so doing, we'll learn how the physical laws that we measure in the laboratory here on Earth apply to the Moon, the stars and places far beyond. We'll learn how to link physical arguments together to see why things work they way they do. The universe is filled with mysteries, but they are unlocked and made even more mysterious in that we can actually understand them.

Natural Philosophy is the study of how logic and evidence links ideas together to come up with explanations for how things work in the real world. We don't have to rely on demons or gods to tell us how things work, and why they go the way they do. We rely of Newton's Laws of Motion, Einstein's Relativity, Maxwell's Laws of Electromagnetism, and the wildly counterintuitive world of quantum mechanics. For many centuries of human existence, we looked at the sky wondered how it all came to be. Now, in this golden era of knowledge and exploration, humanity is coming close to truly understanding the origin of the universe, and discovering whether or not life could actually have arisen more than once in our Solar System.

Don't get me wrong, the ideas are quite challenging, the vocabulary is odd, and the logic that links things together can take serious mental gymnastics, and you'll have to do more reading than you thought you would ever have to for an intro course. But the rewards are great, with this liberal art class that merges science with the greatest aspirations of human thought.

This class will feed and water your inner 6-year-old, and inspire you with wonder. Every kid loved dinosaurs and planets. Now you get to go back and be that kid again.

2. Schedule

COURSE SYLLABUS
(4 Credits)
Fall 2018
Instructor: Jason Kendall
kendallj@wpunj.edu
William Paterson University
Department of Physics

Lecture Online Via Skype or BlackBoard Collaborate Sep. 5, 2018 - Dec. 21, 2018

3. On Excellence

William Paterson University is known for its excellence among its alumni. Excellence is not easily achieved, and takes hard work and significant time. This class and your participation in it are part of WPU's tradition of excellence.

4. Course Objectives

This course is an introduction to astronomy. We'll learn about the concepts of stars, the solar system, and the universe. It will be done in the context of current news in the world of astronomy. We will use not only the text, but will also dig into NASA and astronomy web sites to understand today's amazing discoveries. It is truly a Golden Era of Astronomy, and you'll be exposed to it all. Historical developments in astronomy from ancient mythology to modern science will be covered. Topics include: History of Astronomy, Gravity and Light, The Solar System, our Sun, the Formation and Evolution of Stars, Galaxies, and Frontiers of Exploration.

5. Required Text and Software

(1) **No textbook to purchase**

(2) http://www.itelescope.net/: iTelescope

(3) http://www.stellarium.org: Stellarium

(4) https://www.gimp.org: GIMP Image Processing

(5) https://www.spacetelescope.org: FITS Liberator

(6) https://www.openoffice.org: OpenOffice Office software

6. Student Learning Outcomes

Students will be able to...

(1) Effectively express themselves in written form. Writing is a key component of this class.

(2) Do required mathematics of the class. There will be problem sets where you'll need to show your work.

(3) Demonstrate ability to think critically about new ideas and topics.

(4) Demonstrate ability to integrate knowledge and ideas in a coherent and meaningful manner.

(5) Understand fundamental physical principles, theories, and methods of modern science as practiced in astronomy.

(6) Learn the basic observable phenomena of astronomy, and how these have had both practical applications and played a key role in advancing our understanding of the Universe.

(7) Explain the role of modern technology in the investigation of astronomical phenomena, and the crucial role played by technological advances in extending our knowledge of origin and behavior of the Universe.

(8) Explore how discoveries in astronomy have implications for how we have come to view our place in the Universe, and by comparing the Earth to other planets in our Solar System provide a physical framework for understanding the possible impacts of our activities on the Earth.

(9) Learn and know certain basics of the night sky, including star names, constellations, and how to find astronomical objects using a small telescope.

(10) Finally, it's a LOT of fun. I really hope that you'll become a habitual astronomy buff, looking at Astro stuff frequently, hopefully going to star parties and taking trips out of the City just to see the stars and planets. In short, we hope to add astronomy into your daily life.

7. Pedagogical Method

You come to class not to sit and listen to the instructor talk, but to engage the ideas presented in the course. You'll be asked questions, you'll be challenged to answer in person. You'll also need to learn how to listen actively, and how to read actively. Reading the textbook is central to the class. The class will rely heavily on the reading of the book, writing, web site reading and lab work. I will use the online discussion sessions as an open format. I won't be lecturing, and it's there for you to ask questions and participate. I look VERY favorably on those who read ahead and are ready with questions. The idea with these discussions is to show where you're not sure about something, or what you found exciting and different; or to chat something about something that really doesn't seem right, or is way outside your comfort zone of thinking. There are a lot of hard ideas in the class and in the reading. It will really help if you read it in advance, then bring something to the table. I'll expect a bit of chatter on the discussion events. You'll need to keep up with the reading, because your grade is strongly dependent upon it. Writing and reading are core elements of the class. Talking to your colleagues and friends and family about the topic will not only improve your grade, but help you to truly enjoy astronomy. There are vast astronomy resources online, and we will use them. I can't stress enough how important it is for you to do reading. The laboratory portion will feature hands-on physics exercises as well as active astronomy lab activities that you'll be able to do at home. You will see through a telescope and how to find things in the sky. We will also do a class trip to a nearby observatory.

8. Grading

- "A" students go above and beyond the assignments, achieving mastery over knowledge with enthusiasm. They also challenge themselves to learn something really new for them.
- "B" students essentially do what they've been assigned and do it well.
- "C" students get some and miss some, but know the core concepts.
- "D" students don't understand most of the material, and don't turn in some or most of the assignments.
- "F" students participate only marginally, and what they happen to do shows no understanding or effort.

The following grade scale will be used to assign final grades for this course. All points will be added together for each section, and scaled to their percentage out of 100. However, points can be deceiving. I generally will follow this real formula: "A" students go above and beyond the requirements of the class and show understanding of all topics. "B" students do well and what is required of the class. "C" students get some and miss some, but get most of what's going on in the class. "D" students do not get most of what is going on in the class. "F" students do not make any effort at all, or actively disrupt the class. Grubbing for points won't work. If you're borderline, that's where the above comes in. It is always to your advantage to show up on time and talk about the topics in the class. They will be hard, but you'll get them.

Cumulative final grade letter grade: 90-100: A ; 80-89: B ; 70-79: C ; 60-69: D ; 59 and less: F

9. Online Video Lectures

http://www.jasonkendall.com/AstronomyLectures.
All lectures are online. Go to my personal website at this page above. You are required to watch and take notes on a block of videos each week. You'll be randomly, verbally quizzed on these sessions. We'll start the session with quizzes. Since they are on Youtube, you can always watch in advance. It is also expected that you will peruse and read the links provided under each video on Youtube or on my web pages. Some of the links will be too advanced, but you're expected to be able to chat about the general aspects of the content. The overall goal of the videos is to provide a deep background on the field.

10. Skype/Blackboard sessions

Scheduling will be through Doodle. These sessions are required and weekly, and will require that you will have already watched all the videos for that block, because I'll be giving verbal quizzes over the topics covered to whoever is on the call. They will be in the evening weeknights, after 8pm and ending no later than 10:30pm. Please send me your availability to be on a weekly call. From the availability, I will choose two nights, and you'll be required to be online for one of those two nights. I cannot do every night, therefore, it'll be just those two nights. These sessions are graded and attendance is required, and being ready and having already studied is the method. I'll just ask you questions about it to see how you've done. If someone has a weeknight job, we may do a Sunday morning session as one of the two.

11. Blackboard

WPU uses Blackboard for all grading purposes. Everything that is turned in shall have a grade. I'll also assess an in-class participation grade on Blackboard. It will formalize how you're doing in that regard. The more you interact in class the better.

12. Office Hours

I don't work or live near campus, so there are no office hours. However, I will respond to emails diligently.

13. Laboratory Activities

There are exactly five different lab exercises. All of the lab exercises will be posted on Blackboard and on my personal web page. It is required to check both. I fully expect all students to get together and chat about the course. First make a connection to each other by Blackboard, then work together as you wish and care to. It is in your best interest to do so, and will help you with your studies. Since the lectures are on YouTube, please feel free to post questions directly there. If it's not clear on the youtube video to you, it's likely not clear to others, and I'll need to address it in the comments. So, please do so. Now for the MOST EXCITING part of the class! You will use real telescopes to take real pictures and reduce real data. Assignments will be few in number, but will take time to do. Once you confirm this email, I will set

you up with an account at http://www.iTelescope.net. The Department is paying for your telescope time, so it's free. You'll need to learn how to navigate it, and take images using the acount I will provide. There will be 4 other written-type lab assignments, but the telescope usage on 4 observing assignments and these 4 labs will comprise the assignments of the course. The Skype chats will also be where you ask about the assignments.

14. Assignments and Exams

Lab Work: (40% of your in-class grade) The labs will be done each week in class, however, you'll be able to do them in advance. At the end of the lab section, there will be a lab quiz based off the labs themselves. We will frequently skip lab sessions to take the telescopes outdoors.

Midterm. (15% each of your total grade) Will be online and timed using Blackboard.

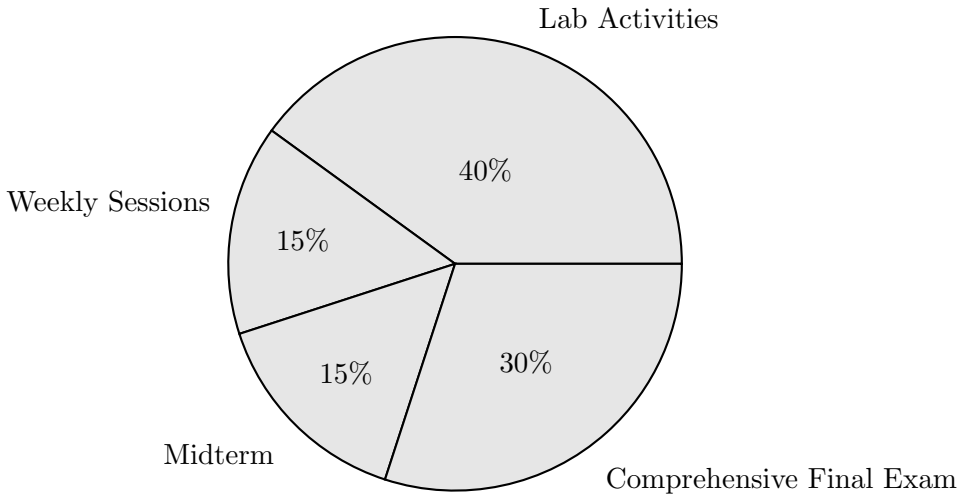
Final Exam: (30% of your total grade) This will be in person and proctored. It can either be proctored on campus or at some other location. The time and location of the proctored exam on campus will be determined in November, but it will fall in the normal finals week schedule. Any off-campus proctoring will have to be done within 24 hours of the on-campus test, and will need to be done in a proper environment. Please let me know if you'll need this option. There can be multiple proctor locations.

Weekly Sessions: (15% of your total grade) You will not always be asked questions during the call, but you don't want to miss it if you are.

15. Fall 2018 Class Calendar

See the WPU Calendar here: https://www.wpunj.edu/registrar/calendars/fall.html

Grading Structure for the Course:



16. Class Topics: Not necessarily in order, and some may be dropped

FOUNDATIONS - FROM ANCIENT TO MODERN ASTRONOMY: We will trace the development of astronomical thought from the geocentric view of the universe to modern astronomy covering the contributions made by Copernicus, Tycho Brahe, Kepler, Galileo, and Newton. Other topics include: The significance of Newton's laws of Motion and Universal Law of Gravitation; our with the view of the sky from the planet Earth and the apparent motion of celestial objects; the diurnal paths of stars; and the apparent annual motion of the sun and planets.

SPACESHIP EARTH: OUR HOME IN SPACE: We'll also cover the three basic motions of Earth – rotation, revolution and precession from a heliocentric point of view and the adoption of Newton's laws; proofs for the Earth's motion. Other topics include: what causes seasons; our view of the sky from different places on Earth; circumpolar stars; and the midnight sun.

LIGHT THE COSMIC MESSENGER & TOOLS OF THE ASTRONOMER: We'll learn about the basic properties of light and matter that enables astronomers to understand so much about the universe. Other topics include: astronomical twilight; how the atmosphere affects the observation of celestial objects; astronomical instruments; reflecting and refractor telescopes; and radio telescopes.

THE MOON: We'll study of the Moon as viewed from Earth and concludes with what we know about our nearest neighbor in space. Among the topics covered are: aspects of the Moon; lunar phases; sidereal and synodic months; lunar tides; solar and lunar eclipses; physical properties of the Moon; lunar surface features; the geology of the Moon; origin of the Moon; unmanned and manned expeditions.

EXPLORING THE SOLAR SYSTEM - THE TERRESTRIAL PLANETS: Looking at the four innermost planets of the Solar System: Mercury, Venus, Earth, and Mars. Among the topics covered are: physical properties of the terrestrial planets; classifying planets; and spacecraft missions .

EXPLORING THE SOLAR SYSTEM - THE JOVIAN PLANETS: We'll cover the study of inner gas giants of the Solar System, Jupiter and Saturn. Among other topics covered are: physical properties of the Jovian planets; and spacecraft missions to the outer Solar System planets. The moon systems of Jupiter and Saturn; and planetary ring systems. Other topics include the study of the outer gas giants of the Solar System, Uranus and Neptune; the physical properties of the minor Jovian planets; and spacecraft missions to the outer regions of the Solar System; and ring systems.

SOLAR SYSTEM VAGABONDS - EXOPLANETS, COMETS, AND DEBRIS: Not to be left out, we'll study the myriad other objects, including comets, that were left over from the origin of the Solar System. Among the topics covered: meteors and asteroids; the mystery of Pluto; trans-Neptunian and Kuiper belt objects.

ORIGIN OF THE SOLAR SYSTEM AND EXOPLANETS: How did the Solar System form?

THE SUN: OUR NEAREST STAR IN SPACE: We'll learn about the structure of the Sun and its effect on the planet Earth. Among the topics covered: The origin of the Sun; What makes the sun shine? The sun's visible surface; and sunspots.

STELLAR PROPERTIES: CHARACTERIZING THE STARS: We'll cover the distances and motion of stars; stellar parallax and proper motions; stellar magnitudes; spectral classification; color-temperature relationships; stellar masses and binary stars.

STELLAR EVOLUTION: BIRTH, LIFE, AND DEATH OF STARS: We'll learn about the lives of stars from birth to death. Among the topics covered: The HR diagram; giant and super giant stars; dwarf and neutron stars; pulsars; nova and super nova explosions; mysterious black holes in space.

THE MILKY WAY GALAXY - AN ISLAND AMONG ISLANDS: We'll analyze the structural features of the Milky Way Galaxy. Other topics include: rotation of the Galaxy; stellar populations; and radio view of our home galaxy; and nebulae and star clusters.

THE GALAXIES: OTHER ISLAND UNIVERSES: We'll learn about the structure of other galaxies in the universe. Other topics include: classification of galaxies; distribution of galactic systems; the local group; clusters of galaxies; Quasars; and active and radio galaxies; and Dark Matter.

COSMOLOGY: THE ORIGIN AND EVOLUTION OF THE UNIVERSE: We'll also learn about the theories for the origin of the universe. Other topics include: evolution of galaxies; the cosmological principle; the age of the universe; the red-shift; Big Bang Theory; dark energy; space and time.