

ASTRONOMY 320 SYLLABUS

ASTRONOMY 320
University of Arizona

Philosophy and History of Astronomical Thought

PROF. MICHAEL CHRISS
Fall 2018

TEXTS: *(highly recommended but not required)* Hoskin: *The Cambridge Illustrated History of Astronomy*, Cambridge Univ. Press
This book is out of print but many copies are available on Amazon and Barnes & Noble.
>>>There are copies reserved for this class in the SO Library, on the 3rd floor of the Steward Observatory.
(required) Chriss: **Handbook for ASTR 320 (find this in the D2L site for this course. Free –of course!)**
(required) **STELLARIUM (this is a computer program that you can download for free)**
(optional- advanced) Bartusiak: *Archives of the Universe*, Vintage 2006. Original papers by the greats in astronomy (Amazon)
(optional- advanced) North: *Cosmos*, Univ. Chicago Press, 2008
North's book is a brand new compendium of information, a brick of a book, encyclopedic in scope.

CLASS MEETINGS: Lectures will be given TTh 2:00-3:15p in room SO 204 .

OFFICE HOURS: Tuesday and Thursday, before or following class, or by arrangement. In SO Parker Library: N304

ATTENDANCE AND ETIQUETTE: Class attendance is important and mandatory. Academic integrity and behavior is required and expected.
(see further attendance and etiquette information in Astr320 Handbook/ Sec.1d.) **No laptops, phones, tablets allowed in class.**

IMPORTANT DATES: 1ST Lecture- Aug. 21st Thanksgiving Break- Nov. 22-25 Last Lecture- Dec. 4th Final Exam- Dec.11 (3:30p)

ATTENDANCE Class attendance is very important. My lectures make up the heart of the class and exams will be based on the classroom topics covered. **To achieve a good grade in this class you must attend all lectures and take good notes.** Attendance will be taken routinely and will be counted in determining your final grade as follows:

- . 1 to 3 absences - no grade penalty
- . 4 to 7 absences - one letter grade lower for semester
- . more than 7 absences - student dropped with a "W" or "E"

[Excess absences made be made up by writing essays from the PREP GUIDES (Sec.5b). See Handbook, Sec 6 and Sec. 5b]

GRADING

EXAMINATIONS 1. 2 midterms and 1 final exam -(multiple-choice, key terms, brief essays), as indicated in the lecture schedule.
2. Students who wish a semester grade of "A" are also required to do additional work (*see below).

There will be 2 midterms + 1 final as indicated in the lecture schedule. Each exam will cover only those lectures which are indicated there:

Exam #1: Lectures 1-9

Exam #2: Lectures 10-16

Exam #3 (final): Lectures 17-27 + previous

The exams will consist of questions originally chosen from the Handbook, **EXAM STUDY-PREP GUIDES (Sec. 5a)**. I will update these study-prep guide questions prior to each exam to eliminate items that will not be on the exam.

GRADING: A = 88% ; B = 78% ; C = 63% ; D = 48% <minimum % scores

[A missed exam will receive a grade of 0. If you miss an exam see me and read Handbook, Sec.6-Grade Improvement Form]

*ADDITIONAL WORK REQUIREMENT FOR "A" GRADE

(1) answer additional essay questions on the final exam

There will be additional essay questions on the final exam for "A" students to answer.

(2) write 9 essays from Study-Prep Guides (Sec.5a) -due on date of final exam.

Hand in 9 essay questions of your choice from Exam #1-3 Study-Prep Guides, with a minimum of 2 essays from each Exam Prep Guide. These 9 essays must be at least one full page per essay, and must be fully and accurately answered.

COURSE LECTURE SCHEDULE (SEC. 1b)

The tentative lecture schedule for the semester,

[see Section 1b in Handbook for details.]

CLASS LECTURE NOTES-TEXTBOOK (SEC. 2)

A "Thin Text" containing the notes and slides of **ALL LECTURES** given in class.

[see Section 2 in Handbook for details.]

HOMEWORKS and READINGS SCHEDULE (SEC. 1c)

HOMEWORK SCHEDULE: Study Guide Questions to prepare and be discussed at our next lecture session (see this Syllabus, p.4) [see Handbook, Sec.1c]

STUDY GUIDE- PREP GUIDE QUESTIONS (SEC. 5)

(Astronomy 320 Handbook, Sec. 5a, 5b + 5c)

1. EXAM STUDY-PREP GUIDES A preview of the questions from which the exams are made up. [see Handbook/Sec. 5a for full details]
2. OTHER HOMEWORK PROBLEMS Additional study problems as assigned. [see Handbook/Sec. 5b for full details]
3. EXTRA CREDIT ASSIGNMENTS Extra credit activities to improve your semester exam grades [see Handbook/Sec. 5c for full details]

Exam Study-Prep Guide questions are found in the Handbook, Sec.5a. *(These questions are updated at the end of each week.)*
These questions are designed to aid in your learning of the material of this course and to help you to prepare for the exams.

HOMEWORK SCHEDULE: Study Guide Questions to prepare and be discussed at our next lecture session (see this Syllabus, p.4) [see Handbook, Sec. 1c, Sec.5a]

- (1) **At The End Of Each Week:** review the Study-Prep Guide questions which relate to the class lecture material of that week.
- (2) **Prior To Each Exam:** you should prepare the updated Study-Prep Guide questions for that exam. *(I will update them at end of each week)*
- (3) **In Addition:** read Handbook/Sec.3-Readings which go with each lecture, as marked.
- (4) **In Addition:** Prepare and Present your 4 Class Discussion papers. (see Handbook/Sec. 4)

DOING WELL IN THIS CLASS:

1. **COME TO CLASS ... EVERYTIME.**
2. **TAKE GOOD LECTURE NOTES IN CLASS ... ON EVERYTHING! <WRITE IT ALL DOWN FULLY, COMPLETELY, ACCURATELY**
3. **REVIEW THE STUDY-PREP GUIDES FOR EACH LECTURE ... AFTER EACH LECTURE.** *(these guides are updated at the end of each week)*
4. **PREPARE THE STUDY-PREP GUIDE FOR EACH EXAM ... (well) BEFORE EACH EXAM.** *[see Lecture Schedule in Syllabus for exam dates]*
5. **READ IN THE READINGS (SEC.3) THAT GO WITH THE LECTURES ... AFTER EACH LECTURE.**
6. **PREPARE AND PRESENT 4 CLASS DISCUSSION TOPICS [SEC.4]** *(see Lecture Schedule in Syllabus for due dates)*

Lecture Dates Approximate

LECTURE SCHEDULE

Lecture Dates Approximate

<p>Aug. 21</p> <p>23</p> <p>28 30</p> <p>Sep. 4</p> <p>6</p> <p>11</p> <p>13</p> <p>17</p> <p>18</p> <p>20</p> <p>25</p> <p>27 Oct. 2</p> <p>4</p>	<p>●●PREHISTORY: THE ROOTS OF ASTRONOMY (prior to 500 BC) <i>Theme: The Cosmic Quest- the search to find our meaning in the universe begins with the search to find our place in the universe.</i></p> <p>L 1 "CLOSED WORLD TO INFINITE UNIVERSE" course introduction and overview</p> <p>L 2 "WHAT IS TRUTH?" – the philosophical foundations of the scientific view</p> <p>THE SKY ABOVE AND THE EARTH BELOW <i>Theme: The starry vault of night becomes the inspiration of ancient culture's religion</i></p> <p>L 3 "THE BOWL OF NIGHT" - motions in the sky</p> <p>L 4 "SKYWATCHERS OF THE ANCIENT WORLD" - archaeoastronomy: Egypt to Medicine Wheel</p> <p>CLASS DISCUSSION #1</p> <p>●●CHAOS TO COSMOS: GREEKS, ROMANS, CHRISTIANS, MOSLEMS: THE FOUNTAINHEAD (500 BC to 1000 AD) <i>Theme: The philosophers of classical Greece find a geometrical logic and design to the structure of the heavens, and man's place in it.</i></p> <p>L 5 "THE MUSIC OF THE SPHERES" - early Greek astronomy: Ionia to Pythagoreans</p> <p>L 6 "THE LOGIC OF THE HEAVENS" - the Socratic philosophers</p> <p>THE COSMIC GEOMETRY <i>Theme: Later Greek philosophers perfect the geocentric model of the universe, and Greek art and architecture embodies this grand cosmic design.</i></p> <p>L 7 "WHEELS ON WHEELS" - the Hellenistic astronomers</p> <p>MICROCOSM AND MACROCOSM <i>Theme: The Greek cosmic model forms the basis for Roman Empire society model and is adapted by the Christians as God's divine plan.</i></p> <p>L 8 } "IDEALS AND PERFECTION" - the Greek ideal of a cosmic art and architecture</p> <p>L 9 } "EMPEROR, GOD, AND COSMOS" – Romans, Christians, Moslems & cosmology</p> <p>-----SO MONDAY NIGHT LECTURE / 7:30p- (M.Chriss)-----</p> <p>CLASS DISCUSSION #2</p> <p><input type="checkbox"/> Exam <input type="checkbox"/> EXAM #1: Lectures 1-9</p> <p>●●THE REBIRTH OF THINKING: THE RENAISSANCE ; NEW HORIZONS FOR MAN (1200 to 1500 AD) <i>Theme: The paradigm shifts. The Renaissance brings new horizons and new viewpoints for man, on earth and in heaven. The old world ends; a new world begins.</i></p> <p>L 10 } "NEW VIEWS OF HEAVEN AND EARTH" - the visions of Luther and Columbus</p> <p>L 11 } "THE NEW PERSPECTIVE" - Renaissance Art and Humanism</p> <p>●●THE SCIENTIFIC REVOLUTION: THE SHATTERING OF THE CRYSTAL SPHERES (1500 to 1700 AD)</p> <p>THE BIRTH OF A NEW WORLD VIEW <i>Theme: A new model of the universe takes shape as Copernicus removes the earth from the center and Kepler discovers the mathematics of planetary motion.</i></p> <p>L 12 "THE EARTH MOVES!" - Copernicus and a new model of the universe</p> <p>L 13 "A MATHEMATICAL UNIVERSE" - Brahe, Kepler; the mathematics of the cosmos</p> <p>THE CLASH OF SCIENCE AND RELIGION <i>Theme: Galileo observes the heavens with a telescope and finds new evidence for the Copernican Theory. He tried by the Inquisition for heresy. The science scene shifts to England, where Newton unites the physics of heaven and earth.</i></p> <p>L 14 "THE CRIME OF GALILEO" - Galileo, the Pope, and the battle for minds</p> <p>L 15 "THE MARRIAGE OF HEAVEN AND EARTH" - Newton and the physics</p>	<p>9</p> <p>11</p> <p>16</p> <p>18</p> <p>23</p> <p>25</p> <p>30</p> <p>Nov. 1</p> <p>6</p> <p>8</p> <p>13</p> <p>15</p> <p>20</p> <p>27</p> <p>29, Dec.4</p> <p>Dec11 3:30p</p>	<p>of the universe</p> <p>L 16 "THE CLOCKWORK UNIVERSE" – fate, free will, and the clockwork universe</p> <p>●●THE POST-NEWTONIAN AGE: THE GROWTH OF THE SCIENTIFIC WORLD VIEW (1700 to 1900 AD) <i>Theme: The scientific method takes form and transforms the world view. The Enlightenment.</i></p> <p>L 17 "SCIENTISTS, ARTISTS, REVOLUTIONS - science societies, art, politics</p> <p>CLASS DISCUSSION #3</p> <p><input type="checkbox"/> Exam <input type="checkbox"/> EXAM #2: Lectures 10-16</p> <p>●●THE 18th and 19th CENTURY: A VISION OF AN INFINITE UNIVERSE (1700 to 1900 AD)</p> <p>EXPANDING HORIZONS AND THE PLACE OF MAN <i>Theme: 18th and 19th century astronomers sweep the skies and discover new worlds around the sun and other suns that form our galaxy: the Milky Way.</i></p> <p>L 18 "THE MEASURE OF THE EARTH" - the voyages of discovery; longitude</p> <p>L 19 "THE FAMILY OF THE SUN" - the discovery of the solar system: Vulcan to Mars</p> <p>L 20 "THE FAMILY OF THE SUN" - the discovery of the solar system: Uranus to Pluto</p> <p>L 21 "THE COSMIC PINWHEEL" - the discovery of our galaxy, from Herschel to Shapley</p> <p>L 22 "THE COSMIC PINWHEEL" - the discovery of our galaxy, from to Shapley to Baade</p> <p>●●THE 20th CENTURY: BRAVE NEW MAN IN A BRAVE NEW UNIVERSE (1900 to 2000 AD)</p> <p>WORLDS WITHOUT END <i>Theme: In the 20th century the astronomers discover an endless universe of galaxies, explore the life of the stars and question whether we are alone.</i></p> <p>L 23 "HUBBLE'S UNIVERSE" – The great telescopes, Hubble and the discovery of the galaxies</p> <p>L 24 "THE GREAT DEBATE & THE SEARCH FOR THE YEAR 0" – superclusters and H₀</p> <p>L 25 "A JOURNEY TO OZ" – stellar evolution and the search for life in the universe</p> <p>CLASS DISCUSSION #4</p> <p>●●THE 21st CENTURY: QUO VADIS MANKIND? BEGINNINGS AND ENDINGS (1900 to present)</p> <p>MODERN MAN AND THE SEARCH FOR MEANING <i>Theme: As the 20th century ends, astronomy, philosophy and theology appear to be asking the same kinds of questions.</i></p> <p>L 26 "EINSTEIN AND RELATIVITY" - 4 dimensions and the shape of space</p> <p>THANKSGIVING BREAK Nov. 22-25</p> <p>L 27 "MAN, GODS, MEANING" – lost in the stars: flat earth to noösphere</p> <p>lecture time as needed</p> <p><input type="checkbox"/> Exam <input type="checkbox"/> EXAM #3: Lectures 17-27 + previous (given during the Final Exam period)</p>
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THEME #1

THEME #2

THEME #3

THEME #4

THEME #5

Astr 320 HOMEWORK and READING SCHEDULE

Fall 2018

COURSE OUTLINE AND LECTURES

This course has been divided into 5 themes, each theme covering one general topic and one historical time period. During each of these periods we will discuss the view of the universe of people living in that period, and how they came to believe in that view. Finally, we will discuss the effect that view had on their lives and their times. [see Astr320 Handbook/Sec.1b-Lecture Schedule for full details]

- THEME #1:** SCIENTIFIC TRUTH:
[Weeks 1-2; Lectures 1-4] What does the sky look like? What is our place in it? How do we know what to believe?
- THEME #2:** THE OLD VIEW:
[Weeks 3-5; Lectures 5-9] Astronomy and society-Greeks, Romans, Christians, Moslems
- THEME #3:** THE NEW VIEW:
[Weeks 6-9; Lectures 10-16] The Scientific Revolution from Copernicus to Enlightenment
- THEME #4:** THE MODERN VIEW:
[Weeks 10-14; Lectures 17-25] Astronomy from Newton to Hubble
- THEME #5:** LINGERING QUESTIONS:
[Weeks 15-16; Lectures 26-27] Life, Religion, God, Meaning

Astr 320 HOMEWORK and READING SCHEDULE

ASTRONOMY 320 Prof. M. Chriss			READINGS IN HANDBOOK- (Sec.3)	READINGS IN TEXT - (Hoskin) <i>Cambridge Illustrated History of Astronomy</i>		
	NO.	(see Handbook Sec. 5a-Study Guide M.Choice Q.)				
THEME #1: SCIENTIFIC TRUTH	1		1.1 - 1.8			
	2	1-1, Brief Bio	2.1 - 2.6			
	3		3.1 – 3.2	pp. 2-21		
	4	3-3	4	22-29		
THEME #2: THE OLD VIEW- Greeks to Moslems	5	4-12	5.1 – 5.2	29-36		
	6	5-16				
	7	6-18		37-47		
	8	7-21	8			
	9	8-27, 9-32		9.1 – 9.2	50-67	
THEME #3: THE NEW VIEW- Scientific Revolution	10	10-2	10.1 – 10.3	68-90		
	11	10-5	11			
	12	11-6		90-97		
	13	12-8; 12-16	13	98-121		
	14	13-24		14.1 – 14.3	122-143	
	15	14-29			144-175	
THEME #4: THE MODERN VIEW Newton to 20 th C.	16	15-35	16.1 – 16.3			
	17	17-2	17			
	18	17-4	18.1 – 18.2	175-183		
	19	18-5		184-197		
	20	19-8				
	21	19-9	21	198-244		
	22	21-11				
	23	21-16			244-343	
THEME #5: LINGERING QUESTIONS	24	23-18				
	25	23-19	25.1 – 25.8	271-329		
	26	25-22	26.1 – 26.4	344-365		
	27	27-36	27.1 – 27.6			

SOME THOUGHTS ON THE IMPORTANCE TAKING NOTES IN CLASS

PLEASE NOTE: LAPTOPS, TABLETS, AND PHONES ARE NOT ALLOWED DURING THE CLASS

I cannot overemphasize the importance of taking good notes on the lectures in this class. IN FACT- to learn the material of this class, and to do well on the exams, you ABSOLUTELY MUST take good notes of each lecture. Your lecture notes will become your textbook in this class.

Learning is a very personal experience. It requires your full involvement:
LISTENING, LOOKING, THINKING, RESPONDING, ASKING:

- **LISTENING**- listen to the lecture, word for word, sentence by sentence, thought by thought.
- **LOOKING**- look at each PowerPoint slide, see what it depicts, understanding what it shows.
- **THINKING**- think about the ideas being presented... think fully and understand it.
- **RESPONDING**- respond vocally in class or in your mind, to each point made, to each question asked.
- **ASKING**- ask any and all questions that you have, and listen to other student's questions (and answers) too.

Laptops do not help you in any of this! They are a form of transcribing but not of thinking. They all too often get in the way of what is important in class. The class requires your full attention; that is the way to understand and to learn. Laptops interfere with this. For all these reasons, they ARE NOT ALLOWED during class lectures.

CLASS LECTURE NOTES / TEXTBOOK (Handbook, SEC. 2)

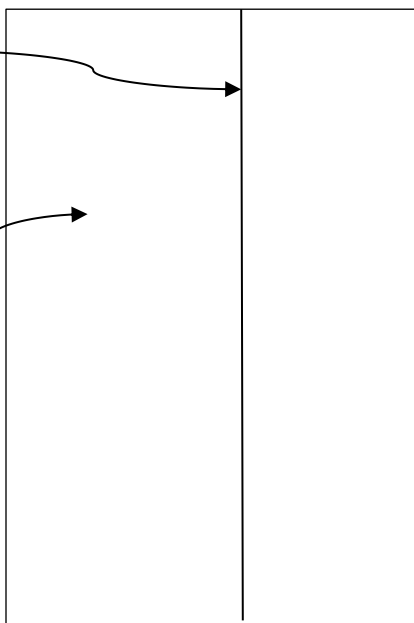
To help in your note-taking, a "Thin Text" of the notes and slides of ALL LECTURES given in class is found in the A320 Handbook, Sec. 2. These illustrated lecture notes are the collaboration of myself and a student, Madison Jean, who took this class in Fall 2017. It is her suggestion -and I fully agree- that:

"Personally, if I were to be retaking the class and had these notes available, I would print them all and follow along in class, highlighting things and adding additional notes by hand. That might be a good suggestion to give your next section of students?"

So, how do you take good notes during a lecture? Here are my suggestions:

On your blank note sheets, draw a vertical line 1/3 from the right edge of the paper.

On the LEFT SIDE ONLY of your page, write the lectures FULLY and COMPLETELY (as close to word for word as possible) [here]



On the RIGHT SIDE you should write 1 of 2 things ONLY:

1. WORDS THAT ARE SPELLED OUT OR EMPHASIZED during the lecture (write it **when you hear them**, even if you are not at that point on the LEFT side of your page as yet).
2. SUMMARIES OR THINGS TO NOTE when you review your notes later on, and when you are studying for exams.

Write these items, more or less, next to what they refer to on the LEFT side.