
The Physics and Astronomy Department at Western welcomes you to the Academic Year 2020/2021 edition of

## Astronomy 2022b: Origin of the Universe

Typically, you would have heard about this course from peers, but in the era of COVID–19, we should not assume what was normal before, so let me say a few things about the *raison–d'être* of this course.

Both the quest for extra–terrestrial life (discussed in A2021A) and the origin of the Universe are topics with ramifications far beyond the natural sciences; one may, fairly so, call these questions metaphysical and thus even reaching beyond the boundaries of human knowledge. For a lecturer to approach these topics with narrow blinkers — I like the German term *Scheuklappen* better, as it captures their purpose to counter the irritability of the wearer; it seems indeed to be irritability what scientists in the postmodern era too often display when naive views of human omniscience are no longer taken for self–evident — does neither justice to these topics, nor to the fair expectations with which students approach these courses. When I have to compromise in this matter, then only because of the unfortunate fact of the modern University to enforce continuous overjustification applied to the learning process in the form of marks calculated for each student (instead of attending to their desire to learn, to understand and to find meaning in the world in which they live).

The syllabus to follow tries to convey how I intend to cope with the sudden paradigm shift towards online learning. Course delivery is hampered by the need to fill numbers into transcripts, often treated as the main purpose of higher education (but luckily completely ignored by employers and, more recently, even professional schools as they state "we don't need people who know how to write tests, we need people with problem solving skills"). To that end, please refer to the Evaluation Summary of the Syllabus, outlining the marking scheme to which all Physics and Astronomy courses adhere; if you find the current uncertainty unsettling take this course as a Discovery Credit and get exposed to the most fundamental questions about life and the Universe you'll ever encounter without worries about marks.

# Course Outline — General Comments

A course outline gives you an overview of the course, in particular (1) its content, (2) its evaluation schemes and (3) the rules applied. It is required at Western University to provide you with a fully accountable product with maximum fairness and equal treatment of all students participating in the course. In this, I adhere to Immanuel Kant's categorical imperative, which you find quoted sometimes in this form: *Never do for one what you are not willing to do for all!*

Western requires all Course Outlines to be filed with the Dean's office by the first day of class. They obviously don't read this material, but if a student disputes the application of any rule in a course, the Dean's office will check what the syllabus states.

When we implement a novel course component or refine an existing one, or, like in the academic year 2020/2021, deal with unprecedented shifts in the educational landscape, then an initially developed set of rules may not meet the objectives as hoped. To remedy this concurrent with the ongoing delivery of the course, syllabus rules may have to be revised or supplemented. Rules affected in this way will appear in the Course Outline for the current year in pink, the same colour in which this sentence is highlighted. We will make every effort to avoid a negative impact on any student's learning experience caused by rule changes after the first day of class. To this end, we will disclose the added text to the Dean if a challenge is based on a provision added in pink. Based on past experience, we are confident that we will meet everyone's expectations of fairness in such cases.

# Instructor Access

Western University requires us to keep a record of all official course correspondence for one year after the completion of the course. Official course correspondence is defined as correspondence received through the meeting point listed below, which is embedded within your OWL website. Messages sent through any other channel, particularly messages sent via email or phone messages are not retained, may not be answered, and are not considered official communications regarding this course. Even if you receive a response, please be advised that such responses might be inaccurate and do not supersede statements made in the course syllabus, the course announcements or through the official meeting point. If communications with students result in amendments to the course syllabus, these are provided in Announcements on your A2022 OWL site.

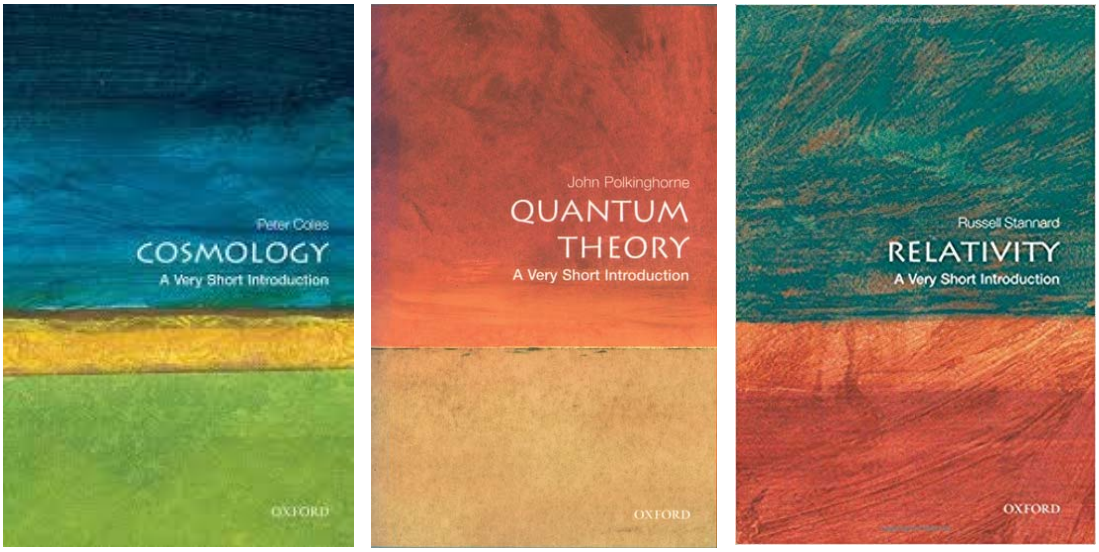
### ▸ Instructor

Dr. M. Zinke–Allmang (working in 2020/2021 from home).
Meeting Point: OWL Astronomy 2022 ➜ Messages ➜ Compose Message: To Zinke–Allmang, Martin (mzinke)
Note: Messages sent this way are **not visible** to other students (unless you send them to everyone, not just the listed instructor).

# Required Course Material

● Textbooks

Cosmology — A Very Short Introduction, Vol. 51, Peter Coles, Oxford University Press
(Abbreviation CO used throughout Syllabus when I refer to this book, shown below at left)
Quantum Theory — A Very Short Introduction, Vol. 69, John Polkinghorne, Oxford University Press
(Abbreviation QT used throughout Syllabus when I refer to this book, shown below at centre)
Relativity — A Very Short Introduction, Vol. 190, Russell Stannard, Oxford University Press
(Abbreviation RE used throughout Syllabus when I refer to this book, shown below at right)




You may obtain these three brooks as a hardcopy bundle in the UWO Bookstore (for about $30) or you can decide to purchase eBooks. In this case, please use the following links:

https://www.vitalsource.com/en-ca/products/cosmology-a-very-short-introduction-peter-coles-v9780191579448?term=9780191579448
$4.00

https://www.vitalsource.com/en-ca/products/quantum-theory-a-very-short-introduction-john-polkinghorne-v9780191577673?term=9780191577673
$4.00

https://www.vitalsource.com/en-ca/products/relativity-a-very-short-introduction-russell-stannard-v9780191574047?term=9780191574047
$4.00

● Access to OWL

You need to have access to a desktop computer or laptop with internet connection. After entering your user id and password, you click on the course tab for your Astronomy course: **ASTRONOMY 2022B 001 FW20**

# A2022B Organon

| Course Component | Textbook Pages | Title |
|---|---|---|
| Listen to this first | — | Content and Form of online<br>[in two parts, recorded together] |
| Unit 1 | CO Ch.1 p. 1 – 11 | From Mythology to Philosophy: Classical Greek Period<br>[contains 8 compulsory parts, 3:48 hours total recording]<br>Hindu Creation (BBC–4)<br>Nature (BBC–4) |
| Unit 2 | — | A careful contemplation of Epistemology<br>[contains 9 compulsory parts, 4:56 hours total recording]<br>Bergson and Time (BBC–4)<br>Brain and Consciousness (BBC–4)<br>Consciousness (BBC–4) |
| Intermission | — | Intermission: The Ontology of Colours<br>[bonus material] |
| Unit 3 | CO Ch. 7, p. 93 – 106<br>CO Ch. 4, p. 39 – 56 | Cosmology as a Natural Science: Astronomical Observations<br>[contains 6 compulsory parts, 3:45 hours total recording]<br>Origin of the Universe (BBC–4)<br>Age of the Universe (BBC–4)<br>Galaxies (BBC–4)<br>Dark Matter (BBC–4) |
| Unit 4 | QT Chs. 1 – 3, 6<br>p. 1 – 57, 82 – 92 | Beyond Human Experience I: Quantum Theory<br>[contains 7 compulsory parts, 3:10 hours total recording]<br>Measurement Problem in Physics (BBC–4)<br>Quantum Gravity (BBC–4) |
| Unit 5 | CO Ch. 2, p. 12 – 26<br>RT p. 1 – 79 | Beyond Human Experience II: Relativity<br>[contains 7 compulsory parts, 2:27 hours total recording]<br>Time (BBC–4)<br>Physics of Time (BBC–4)<br>Speed of Light (BBC–4)<br>Relativity (BBC–4) |
| Unit 6 | CO Ch. 3, p. 27 – 38 | Complete Revamping of Cosmology: 1915 – 1930<br>[contains 5 compulsory parts, 1:47 hours total recording]<br>Black Holes (BBC–4)<br>Universe's Shape (BBC–4)<br>Poincare Conjecture (BBC–4) |
| Unit 7 | CO Ch. 5, p. 57 – 73 | Big Bang Theory<br>[contains 6 compulsory parts, 2:06 hours total recording]<br>Grand Unified Theory (BBC–4)<br>Antimatter (BBC–4)<br>Multiverse (BBC–4) |
| Unit 8 | CO Ch. 6, p. 74 – 92<br>CO Ch. 8, p. 107 – 127 | Ontology of the Universe and its Future<br>[contains 7 compulsory parts, 2:15 hours total recording]<br>Graviton (BBC–4)<br>Dark Energy (BBC–4)<br>Vacuum of Space (BBC–4)<br>Theory of Everything (BBC–4) |
| Farewell | — | Epilogue: So what is Nature then?<br>[bonus material] |

IN BLUE — Compulsory Material: on the exams
IN GREEN — Bonus Material: not additionally required for the exams
Abbreviations CO = Cosmology, QT = Quantum Theory, RT = Relativity

# Astronomy 2022B

## Learning Outcomes

### (1) Broad Learning Outcomes

At the end of the course you will be able to

- assess within the framework of the natural sciences the uniqueness of our Universe;
- demonstrate a conceptual understanding (comprehension) of Quantum Theory;
- demonstrate a conceptual understanding (comprehension) of Relativity; and,
- know the definitions of terms and explain the basic models/theories associated with the Big Bang theory.

### (2) Granular Learning Outcomes

These learning outcomes are provided for each Unit. Thus, when material is discussed a second time from another point of view, (R) is used to indicate that a learning outcome has already been used before *if it was included in Units 1 – 4*. Note that some learning outcomes encompass quite a bit of background material that is implicitly assumed to be understood! By the stated point in the course, you should be able to

#### 1. Unit 1 (From Mythology to Philosophy: Classical Greek Period)

a. distinguish epistemology and ontology as subfields of metaphysics;
b. identify key characteristics of prehistoric and ancient mythological belief systems;
c. define the four or five elements that constitute matter in ancient Greek ontology and discuss their relations;
d. discuss the concepts change and motion from an ancient Greek philosophical perspective;
e. establish the key elements of Aristotle's cosmology;
f. discuss the cosmos in the Platonic, Aristotelian and Ptolemaic traditions;
g. discuss the role of Plato's Allegory of the Cave in the context of ancient Greek epistemology;
h. define how Aristotle rationalized motion in the sublunar realm;
i. identify ancient Greek schools that challenged Aristotle's views;
j. define retrograde motion and rotation and the rationale provided by Ptolemy for their occurrence;
k. distinguish the role of observation and speculation in ancient philosophy.

## 2. Unit 2 (A Careful Contemplation of Epistemology)

a. Describe the Cartesian concept of space;
b. describe the Newtonian concept of space;
c. reproduce, understand and explain the Kantian model of the human mind, in particular the role of inner and outer intuition;
d. distinguish the logical functions of the faculty of thinking, and their role in the online and offline systems of cognition;
e. explain how external objects are spatially ordered in the brain;
f. explain the distinction between “the thing itself” and its appearance using the observation of Mach bands and the Taj Mahal;
g. describe the detection of the direction of head acceleration with the semicircular canals of the vestibular organ, and its role in spatial disorientation;
h. describe free fall on Earth and the motion of the Moon around Earth based on Newton’s law of gravity;
i. describe the criticism of Newton’s law of gravity and Newton’s concept of space, as discussed by later scientists, such as Mach;
j. describe how the human mind knows the direction of gravity.

## 3. Unit 3 (Cosmology as a Natural Science: Astronomical Observations)

a. discuss the structure of the Universe at different lengths scales;
b. describe what a rotation curve measures and how it provides evidence for dark matter;
c. discuss the evidence for a central black hole in the Milky Way;
d. explain how distances to galaxies are determined;
e. explain the concept of *lookback time*;
f. explain the relationship between galaxies and their central black holes;
g. describe the evidence for the expanding universe;
h. explain *Hubble’s Law* and how it does not imply a centre for the Universe;
i. describe the Doppler effect and discuss its role determining Hubble’s law;
j. explain why there is a *cosmological horizon*;
k. describe the relation between our the expansion rate of the Universe and its age;
l. define the term *cosmic microwave background,* and describe the problems for cosmology arising from its uniformity.

## 4. Unit 4 (Beyond Human Experience 1: Quantum Theory)

a. list the tenets and basic findings of quantum theory;
b. explain what a quantum state is in quantum theory, and describe in particular the orbitals of a hydrogen atom based on Schrödinger’s equation;
c. distinguish model predictions and physical observations and results of experiments;
d. describe the role of the Stern-Gerlach experiment and the double-slit experiment in the development of quantum theory;
e. describe atomic spectra and their origin in Bohr’s atomic model;
f. describe black body radiation, the role of Planck’s quantum hypothesis and the application to the observed cosmic background radiation;

g. characterize the concept of particle-wave dualism;
h. describe Heisenberg's uncertainty relations;
i. describe the tunneling effect and the concept of energy density of a vacuum;
j. describe Pauli's exclusion principle for Fermions, both in its role in the periodic system of elements and in the development of degeneracy pressure in astronomical objects, such as brown dwarfs and white dwarfs;
k. describe the role of probability amplitudes, probabilities and observables in quantum mechanics;
l. describe the measurement problem of quantum mechanics and its proposed solutions.

## 5. Unit 5 (Beyond Human Experience 2: Relativity)

a. Distinguish Einstein's Special Relativity of 1905 and his General Relativity of 1915;
b. describe Galilei's principle of relativity and relate the speed of light to familiar velocities;
c. distinguish the concepts of space and time as developed by Einstein and Minkowski from those of Descartes and Newton;
d. describe the concepts of time dilation and length contraction in relativity;
e. relate the structure of the Lorentz transformations to the concept of space-time;
f. discuss the loss of simultaneity and its relation to the concept of block universe;
g. write Einstein's mass – energy relation and discuss its relevance in fusion, fission and astrophysics;
h. summarize the various versions of the equivalence principle;
i. describe how acceleration and/or gravity affect time;
j. describe what we mean with curved space-time;
k. describe how light travels near massive objects;
l. outline the first experimental confirmation of General Relativity with the precession of the perihelion of Mercury.

## 6. Unit 6 (Complete Revamping of Cosmology: 1915 – 1930)

a. Describe the role of space-time curvature near massive objects and for the universe in its totality;
b. describe the application of General Relativity to stellar and supermassive galactic black holes;
c. explain the concept of escape velocity in the context of the formation of black holes, their abundance in the Universe;
d. describe the concepts of singularity and event horizon based on General Relativity;
e. describe the cosmological principle;
f. explain the role of Einstein's cosmological constant;
g. relate the idea of a Big Bang to Hubble's law;
h. relate Hubble's law with the expansion of space, i.e., explain the cosmological redshift (R);
i. describe the concept of lookback time (R);
j. describe the horizon of the visible Universe (R).

## 7. Unit 7 (Big Bang Theory)

a. explain what is meant by *Big Bang theory* and list the current evidence for it;
b. define and use the term *cosmic microwave background*;
c. give the relationship between time, energy, and temperature in the early universe;
d. describe what happened (and approximate timescales) for the various eras in the early universe;
e. arrange the major epochs of the early universe in order of increasing time.

## 8. Unit 8 (Ontology of the Universe and its Future)

a. explain the effects of gravity on the expansion of the Universe;
b. define the terms dark matter and dark energy; and describe their overall role and need in the contemporary cosmological description of our Universe;
c. list the pieces of evidence for dark matter;
d. describe the evidence for dark energy;
e. list the candidates for each phenomenon and their prospects for detection, and;
f. explain the possible fates of the universe and how these relate to the matter and energy densities.

# Evaluation Summary

Fall/Winter 2020/2021

| Course Component | Available: OWL Tests&Quizzes | Component Weight | |
|---|---|---|---|
| Unit Content Review Quizzes 1 – 8 | January 11 – April 12 (always from Noon to Noon) | Duration: 15 min * 10 Questions | cumulative need 20 for 14 % |
| In Our Time broadcast Quizzes (19 recordings available) | January 11 – April 12 (always from Noon to Noon) | Duration: 1 hour * 4 Questions | cumulative need 40 for 20 % |
| Exam Component I ** (Unit 1 – Unit 4) | April 14 – April 30 (always from Noon to Noon) | Duration: 90 min 32 Questions | 33 % |
| Exam Component II ** (Unit 5 – Unit 8) | April 14 – April 30 (always from Noon to Noon) | Duration: 90 min 32 Questions | 33 % |

* The Teaching Support Centre at Western advised instructors as follows:
*Arranging Accommodated Exams for Students with Disabilities*
*For online timed assessments:*
*Instructors are very strongly encouraged to employ the principles of Universal Instructional Design (i.e. providing 4 hours to all students to complete a 2-hour assessment) to avoid the need to accommodate students with disabilities. This is best practice.*
I will follow this advice for Unit Content Review Quizzes (thus available 30 minutes each) and In Our Time Broadcast Quizzes (thus available 2 hours each).

** Makeup privileges granted only if documentation is provided showing no availability for the entire exam period.

The Department of Physics and Astronomy may, in exceptional cases, adjust the final course marks in order to conform to Departmental policy.

# Unit Content Review Quizzes (UCRQ)

We suggest to complete Unit Content Review Quizzes once the material of a Unit has been studied, i.e., the mp3 Recordings of a Unit (utilizing the pertinent Powerpoint slides and Demonstration Videos) have been attended and the assigned sections in the textbooks have been read.

- Number of Quizzes:

8 Unit Unit Content Review Quizzes are provided throughout the Winter term (corresponding to Units 1 to 8 of the course material), called UCRQ–1 through UCRQ–8 in Tests&Quizzes of your A2022B OWL site.

- Content of Quizzes:

Each Quiz contains 10 questions (selected randomly from a larger pool of questions for this Unit). As therefore every student will see a different set of questions, we state that these are not suitable as rehearsal material for the examinations in this course; separate Rehearsal material is provided for this purpose.

- Dates available:

Each quiz is available throughout the class–part of the term, i.e., they do not extend into Study Days or the subsequent exam period. For details on dates, please refer to the file 30_Evaluation_General of the Syllabus.
Each Quiz will be accessible from Noon (12:00) on the date it opens until Noon (12:00) the date it closes.
**Note: Noon is midday, not midnight!**

- Other quiz details:

You receive one point for each correct answer. You have only one attempt, so be careful not to open the wrong quiz!

- Evaluation:

Each question in each quiz counts as 1 point (correct) or 0 points (incorrect). Thus a maximum of 80 points can be reached — Your cumulative point value I call X, and the threshold you need to reach for the full course component mark I call T. The course component contributes Z% to your Final Course mark (for the values of T and Z, please refer to file 30_Evaluation_General of the Syllabus). At the end of the term we calculate the value of the pertinent OWL Gradebook column (Y) as: Y = Z if $X \geq T$ and Y = X*Z/T if $X < T$; rounded to one decimal point.
For further details on course component evaluations, please refer to the file 30_Evaluation_General of the Syllabus.

- General Comment: Check all your scores in the Gradebook of OWL at least on a weekly basis

If there is a discrepancy, you must notify us within one (1) week of the completion of a Quiz as ITS does not like to backtrack farther than that. That is, **all marks and points posted in the Gradebook are considered final one week after posting.**

**We will not consider any adjustments for whatever reason. Each quiz is available for essentially the entire term and can be completed from a laptop/computer anywhere on the planet, even when required to self–isolate. If you miss such a significant fraction of a course, we recommend that you withdraw and retake the course the next time it is offered.**

Note that you may have to update software, such as your version of JAVA. Try first, if it doesn't work, please contact the ITS Helpdesk at Ext. 83800 (off–campus at 519 661 3800).

**Important disclaimer: *Counsellors in the various Deans' offices do not approve accommodations*. They only validate documentation you submit with respect to missed course components and confirm this in your student file online. It is your obligation to contact course coordinators to discuss arrangements, but only if, as a result, an accommodation is warranted, that is in particular, the time missed includes the entire window for the affected course component.**

# In Our Time Broadcast Quizzes (IOTBQ)

As a degree holder of a Canadian University, it is assumed that you can follow conversations on a subject matter you have studied. What this means, however, is usually not evident when you take a breadth course. Fore this purpose, on various subjects of broader interest pertaining to the course material we cover in Astronomy 2022, we provide you with a set of mp3 Recordings of the BBC–4 programme *In Our Time*, moderated by Melvyn Bragg (https://www.bbc.co.uk/programmes/b006qykl/episodes/guides)*. Your participation is recorded through a set of questions accessible with each recording. The BBC–4 broadcasts usually last for 30 to 45 minutes, the quiz questions will be available longer; thus we recommend you open the quiz, briefly review the four questions before enjoying the programme Melvyn Bragg and his guests provide.
*On this website, you also find the rules for use of the *In Our Time* BBC Radio 4 broadcasts; please note, that these apply even if you download a broadcast from your OWL site.

● Number of Quizzes:
25 *In Our Time* Broadcast Quizzes are provided throughout the Winter term, they are labeled IOTBQ–U*, where U* stands for the Unit number, followed by the title of the broadcast.
These are provided in Tests&Quizzes of your A2022B OWL site.

● Content of Quizzes:
Each quiz contains 4 questions (selected randomly from a larger pool of questions for this broadcast)

● Dates available:
The quizzes are available throughout the class–part of the term, i.e., they do not extend to Study Days/exam periods. For details on dates, please refer to the file 30_Evaluation_General of the Syllabus

● Other quiz details:
You receive one point for each correct answer. You have only one attempt, so be careful not to open the wrong quiz! The quiz is available longer than the broadcast lasts, however, do not delay the broadcast for more than 10 minutes. Also, we **do not** recommend to listen to the broadcast first, then start the quiz, as many questions refer specifically to something (e.g., a number) mentioned in the broadcast and are impossible to memorize for later.

● Evaluation:
Each question in each quiz counts as 1 point (correct) or 0 points (incorrect). Thus a maximum of 100 points can be reached — Your cumulative point value I call X, and the threshold you need to reach for the full course component mark I call T. The course component contributes Z% to your Final Course mark (for the values of T and Z, please refer to file 30_Evaluation_General of the Syllabus). At the end of the term we calculate the value of the pertinent OWL Gradebook column (Y) as: Y = Z if $X \geq T$ and Y = X*Z/T if $X < T$; rounded to one decimal point.
For further details on course component evaluations, please refer to the file 30_Evaluation_General of the Syllabus.

● General Comment: Check all your scores in the Gradebook of OWL at least on a weekly basis
If there is a discrepancy, you must notify us within one (1) week of the completion of a Quiz as ITS does not like to backtrack farther than that. That is, **all marks and points posted in the Gradebook are considered final one week after posting.**

**We will not consider any adjustments for whatever reason. Each quiz is available for essentially the entire term and can be completed from a laptop/computer anywhere on the planet, even when required to self–isolate. Once you miss such a significant fraction of a course, we recommend that you withdraw and retake the course the next time it is offered.**

Quizzes can be completed at any computer connected to the internet, including at home. mp3–broadcasts can also be listened to with any computer connected to the internet and equipped with suitable speaker technology. If you require technical assistance, please contact the ITS Helpdesk at Ext. 83800 (off–campus at 519 661 3800).

**Important disclaimer: *Counsellors in the various Deans' offices do not approve accommodations*. They only validate documentation you submit with respect to missed course components and confirm this in your student file online. It is your obligation to contact course coordinators to discuss arrangements, but only if, as a result, an accommodation is warranted, that is in particular, the time missed includes the entire window for the affected course component.**

# Examinations

For this course, we run two examination components, each covering half the course — this corresponds to the traditional non–cumulative Midterm and Final approach. Each of the examinations is available to you throughout the April exam period; this allows you to accommodate your preparation most flexibly through the term, and during the exam period by taking the schedule of your other exams into consideration.

- Number of Examinations:

2 Exam Components during April Examination period —
Examination I (corresponding to Units 1 to 4 of the course material), and
Examination II (corresponding to Units 5 to 8 of the course material)
These will be called Exam–I–U1–U4 and Exam–II–U5–U8 and will be available through the TAB Test&Quizzes on the OWL site

- Content of Examinations:

Each Examination component contains 32 questions to be completed in 1.5 hour (90 minutes). Note that the questions are randomly selected from a larger pool of questions for each Unit.

- Dates available:

Each Examination component is available throughout the April examination period. For details on dates, please refer to the file 30_Evaluation_General of the Syllabus.

- Other Examination details:

You receive 1 point for each correct answer and 0 points for incorrect answers. Needless to say, you will have only one attempt, so be careful not to open the wrong examination!
Aids: this is an open textbooks exam, please have the textbooks and your notes (in electronic form and/or print) ready when starting each of the examinations in this course.

- Evaluation:

Each examination contributes Z% to your Final Course mark (for the value of Z, please refer in the Syllabus to file 30_Evaluation_General). Assuming you answer correct X questions, we calculate the value of the pertinent OWL Gradebook column (Y) as: Y = X*Z/32, rounded to one decimal point and capped at Y = Z. For further details on course component evaluations, please refer to the file 30_Evaluation_General of the Syllabus.

- Reasons the Dean's office may accept for missing the final examination:
  - Serious personal illness, for which you need to provide medical documentation covering the entire examination period, see 40_Small Print;
  - Bereavement of an immediate family member;
  - Religious Holiday (must be a holiday officially recognized by Western and must stretch the entire exam period. It must be filed in advance of the examination period; see the Dean's office for filing deadlines, which are usually well ahead of the examination period);
  - Exam scheduling conflicts — not applicable.

In each case, supporting documentation must be filed with the Office of the Dean of your Faculty. If you either know in advance that you will miss an exam or you have missed an exam, do not contact your lecturer or the Departmental office: we cannot grant you permission to write a makeup exam — you must contact the Dean's counselling office of your Faculty.

● What happens after the exam?

You have two avenues to challenge your mark on the final exam or in this course: Within one week of posting and publishing the marks (in the OWL Gradebook) ...

○ you request a review of the exam (how this will be done will be determined by the Chair of the Physics and Astronomy Department of his/her delegate), then formulate a challenge to one or more questions and provide your rationale. This you submit to the course instructor who reports back to you with a decision — or, ...

○ you provide a request for a mark revision on compassionate grounds. Reasons given must severely have affected your course performance, usually in more than one course, and must be supported by documentation that has been submitted prior to the Dean's office. Again, the instructor reports back to you with a decision.

If you are not satisfied with the decision, you are allowed to carry your appeal to the next stage, i.e., the Chairman of the Department of Physics and Astronomy. We will provide to the Chair your initial request for an appeal, and all material he/she considers useful to come to a decision. Prior to proceeding with such an appeal, you may consult with the Chair or the Dean's office regarding rules that govern such appeals, as these change from time to time, often without notice provided to your instructor. While you are entitled to see your exam for one year (again, what this entails will have to be decided by the Chair of the Physics and Astronomy) after the exam has been written, timely action is needed if you feel that the mark does not properly reflect your performance in the course.

# The Small Print

## Special mention for online courses in Academic Year 2020/2021

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face–to–face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well–being: https://www.uwo.ca/se/digital/

Learning–skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple choice exam preparation and writing, textbook reading, and more. Individual support is also available.

Students who find themselves in emotional and/or mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

Additional student–run support services are offered by the USC at http://westernusc.ca/services

## Changes to Western Bookstore Services for 2020/2021

To accommodate courses that are being offered online, and students that are not residing in London, the Bookstore will offer the following services for the Fall term (I assume that these apply to the Winter term as well):

- Online ordering of physical (paper) books and/or Custom Course Materials (e.g., lab manuals) through the Bookstore website. Items can be shipped to students directly (online order at bookstore webpage) if they are learning remotely.
- Students buying books on campus will have the option of some form of curbside pickup
- Obtaining commercial electronic books, to be sold through the Western Bookstore website (depending on publishers' availability).
- Converting Custom Course Materials (textbooks or lab manuals) to an electronic format. The e–books will be accessible only via the Bookstore's online platform. Students will not be able to download the content for offline access. But instructors can select certain pages to be printed out by the students.

If you have any questions or want to place an order, contact Rachel Sandieson, Course Materials Manager at rsandies@uwo.ca

## General

This file constitutes part of the Syllabus and contains two types of information:

- Information that we have to include in the Syllabus due to Senate regulations, or pertinent requests by the Dean's office or the Registrar.
- Information on bureaucratic details such as how we handle complaints, mark postings, plagiarism (cheating), student's responsibilities, medical notes, and related formalities.

## Course Description

Astronomy 2022A/B: The Origin of the Universe

Calendar Description: This course is designed for non–science students* as an introduction to current ideas about the universe. Topics include the Big Bang, cosmic microwave background, origin of elements, and origin of galaxies, stars and planetary systems.

(* this term is not meant as an insult to you, that is, we recognize that the endeavours of discovery and dissemination of knowledge in your field of expertise also meet the requirements of a science. The term *Non–science student* is defined at Western University as describing a student whose program is not administered

by the Faculty of Science.)]
Antirequisite(s): Earth Sciences 1086F/G, Physics 1028A/B, 1301A/B, 1401A/B, 1501A/B (or a list of courses that existed many years ago).
Prerequisite(s): none
2 lecture hours, 0.5 course (offered online only in Fall/Winer 2020/2021)
May not be taken for credit by students in the Faculty of Sciences.
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

## Discovery Credits

As of the 2018–19 academic year, students have had the option to declare a course as a "Discovery Credit," so that it is graded as pass/fail on their transcript. This privilege is open only to students in their second year or higher, and cannot be used to meet a student's modular requirements or essay requirements. Instructors will not know which students have declared their course as a Discovery Credit, and are expected to provide the same assessments, evaluated to the same standards, to all students.

## Complaints and Suggestions

If you have a genuine concern about something, please communicate with us. We rely on your feedback. Please contact initially the person most directly concerned; this will usually be one of the team members. If that does not work, or there is something more general bothering you, talk it over with the Chairman of the Department of Physics and Astronomy.

## Where do I find my marks?

All current marks are posted and updated in a timely and regular fashion on the course OWL website. It is your responsibility to check the listings for accuracy on a regular basis. Errors must be reported to your lecturer within one (1) week of initial posting.
The course mark will be posted on this site and on the official Registrar's site. It is your responsibility to check the accuracy of the official Registrar's posting.
Under no circumstances will the Department of Physics and Astronomy release marks over the telephone, nor will we issue individual replies per email with final marks. If you have a valid reason to obtain this information ahead of the official posting on the Registrar's web site, please contact us in advance.

## Student's responsibilities

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at 661–2147 if you have any questions regarding accommodations.
Link to the policy on Accommodation for Students with Disabilities
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf
You are responsible to contribute your share to an orderly conduct of the lectures and the out–of–class activities relating to this course. This includes in particular a responsibility to maintain the technical tools you are using in this course:

- Your course OWL website

You must access this site on a regular basis to find quizzes, updated grades, communications by the course instructor through announcements, and online course material. Neglect of maintaining an overview of the material on this site does not constitute a reason for exemption of any or all course components. For OWL–related help, contact the ITS Help Desk at Ext. 83800, or, off campus, phone 519–661–3800.

- Data Security

Note: all data we acquire in this course are uploaded to the Gradebook. At the end of the term, these data are

downloaded into an Excel file that is maintained as the master file for this course. We retain these files for one (1) year. After that time, we may no longer be in a position to provide details on your marks to the Dean's office. This is relevant to all those who have a dispute about course marks, or request the Dean to review their marks in a summary fashion when being asked to withdraw from the University. Thus, make sure that the Final Mark, as posted on the registrar's site, is correct.
We guarantee our students that none of their marks are released to any other party than the Dean's office of the student. All course marks are calculated and uploaded by the lecturer in this course.

- Laptops

Your laptop allows you access to OWL and the various components on this web page, including all online components. It is your responsibility to ensure that any equipment you use to complete tasks in this class are functioning properly. If you encounter problems with a computer, consult with the ITS HelpDesk at Ext. 83800 or, from off–campus, at 519–661–3800.

## Plagiarism

Plagiarism is the University's word for cheating, and there are severe penalties involved. Please refer for the definition of what constitutes a Scholastic Offence, at the following Web site:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf
Thus, there are further Academic Offenses not mentioned explicitly in this Course Outline which apply.
Note that these rules apply to any form of participation in a mark–sensitive component in this course. We point out in particular a few maybe less obvious cases – however, even if the particular form of cheating is not listed below, but is identified in the University Calendar, penalties still apply:

- You are not permitted to login to the course OWL website with any userID / password other than your own. In particular, by submitting an answer set to a quiz online, you confirm that its content is your own work.

## Absences and Medical Notes

(Policy on Academic Consideration for Student Absence)

Students have up to two (2) opportunities during the regular academic year to use an online portal to self–report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self–reported absence, unless otherwise noted in the syllabus. NOTE: Students are not able to use the self–reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self–reporting portal twice during the academic year

If the conditions for a Self–reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences that are not covered by the Self–reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.

For policy on Academic Consideration for Student Absences, see:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

and for the Student Medical Certificate (SMC), see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Note that it is your Dean's responsibility to assess your documentation and formulate a recommendation for accommodation to course instructors. Once the Dean's office and the course instructor have arrived at an appropriate accommodation, you will be informed. If this accommodation includes arrangements alternative to the regular course outline, we will discuss this with the student. If the student is agreeable to these accommodations, they will be applied; if not, additional discussions between the Dean's office, the course instructor and the student will take place to resolve outstanding issues.

## Conflicts due to Religious Holidays

Link to the policy on Accommodation for Religious Holidays
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

## Other useful links

Link to the website for Registrarial Services:
http://www.registrar.uwo.ca
Link to learning skills services at the Student Development Centre:
http://www.sdc.uwo.ca
Link to services provided by the University Students' Council:
http://westernusc.ca/services/