SYLLABUS for course ASTB23, Title: Stars, Galaxies & the Universe
Fall 2017. The contents may change; please download updated syllabus ~every week.

Lectures: Thursdays 12:00-14:00 AA206. Tutorials: Thur. 17:00-18:00 IC204,
(no tutorial at first meeting)
Calendar od lectures (L1...L24) and tutorials (T1...T10) with remarks:

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7 Sept.	L1 + L2,	--	
14 Sept.	L3 + L4,	T1	(last day to add/remove courses 18 Sept)
21 Sept.	L5 + L6,	T2	
28 Sept	L7 + L8,	T3	
5 Oct.	L9 + L10,	T4	
12 - no meetings, reading week			
19 Oct.	L11 + L12,	T5	
26 Oct.	L13 + L14	T6	<--- in-class midterm during T6
2 Nov	L15 + L16,	T7	
9 Nov.	L17 + L18,	T8	
16 Nov.	L19 + L20,	T9	(last day to drop courses w/o penaly 20 Nov)
23 Nov.	L21 + L22,	--	
30 Nov.	L23 + L24,	T10	

Final exam: date TBA (exam session 7-20 Dec)
[2 double-sided hand written (not printed or photocopied) sheets, i.e. 4 pages of own notes are allowed at midterm, and 3 sheets (6p.) during the final exam.
Calculators are required. Books, phones, other electronic devices not allowed.]

Office hours: right after lectures, right after tutorial; other times as well,
stop by and ask if you can talk to me.

Note: The updates to this syllabus will always be here available from the course
web page: http://planets.utsc.utoronto.ca/~pawel/ASTB23
With some exceptions the topic number below coincide with lecture number.
See web page for textbooks. In the second part of the course the provided
PDF lecture notes will important.
The relevant chapters/sections of the textbook #3 are indicated as,
for instance, Chapter 5.1, => [5.1], while [L10] would indicate
Lecture10 in PDF/PPT form, posted on our web page

0. Organization and goals of the course

1. Introduction to stellar (and planetary) astrophysics [L1]
   * Unification of planetary sciences, connections w/physics
   * Comments on the history of the idea of other stars and planets

2. The Present Revolution in Astronomy: An Overview
   [1-Unnumbered] From p. xvii of textbook 1.

PLEASE READ - it's a very good overview, we skipped it during the lecture as it is indeed long, but you should read the whole 150+ page textbook, and questions from the this Overview may be asked on the quiz, as they relate to the Universe, for instance.

Until the midtem, we will follow closely our textbook 1 ("What are the stars")

* The Strange Companion of Sirius 25
* Gravitational Redshift 27
* A Stellar Paradox: Have the Stars Enough Energy to Cool? .

10 5. Fermi-Dirac Distribution 55
* Pauli’s Exclusion Principle 55
* The Fermi-Dirac Distribution 56
* Pressure laws of the Degenerate Electron Gas 58
* Fermi Momentum 60

11 6. Quantum Stars 67
* Fowler and Chandra 67
* Chandrasekhar’s Theory of the White Dwarfs 71
* All Stars will Ultimately Find Peace 77

12 7. The Chandrasekhar Limit 79
* Relativistic Stars 79
* Chandrasekhar limit 84
* Can All Stars Find Peace? 90

The 2nd part: Sparke and Gallagher book "Galaxies in the Universe"

13. Formation of disks and stars
* Giant molecular clouds
* Jeans instability of protostellar cloud cores
* Opacity-limited fragmentation
* Simulations: the ubiquity of protostellar disks, brown dwarfs

Accretion disks [9]
* AGN and quasars: accretion onto `black' holes
* Accretion disk geometry
* Disks as evolving, shearing flows
* Collapse simulations using SPH (smoothed particle hydrodynamics)

14. Introduction, The Milky Way [1]
[1.a] History of the discovery of the Galaxy
[1.b] The Great Debate about galaxies
[1.1] The stars
[1.2] Our Milky Way

15. [1.3] Other galaxies, Galaxy photometry
Hubble sequence, other classifications
[1.4] Galaxies
Typical properties and statistics of of galaxies
Gauss theorem and examples of its use. Laplace equation
Gravity force and potential
Spherical systems & Newton's theorems
Potentials of some simple systems
Potential- density pairs of flattened systems

16. [2] Mapping our Milky Way
[2.1] The solar neighborhood 2.2 The stars in the Galaxy
The vertical structure of the disk / Distances to star clusters /
Bottliger diagram, asymmetric drift

17. [2.3] Galactic rotation
Infrared & radio view of the Milky Way
Glactic bulge and Center (Nucleus)
Measuring the Galactic rotation curve

18. Relaxation and evolution, part I
    [3] The orbits of stars
    [3.2] Why the Galaxy isn't bumpy: two-body relaxation, encounters
    Relaxation time: theory and the inferred histogram for globular clusters

19. Relaxation and evolution, part II
    The virial theorem / Evaporation / mass segregation
    Effects of two-body relaxation: core collapse of globular clusters
    [3.x] Angular momentum and energy conservation in stellar motion
    Epicyclic theory of orbits in galactic potentials
    epicyclic frequecy, vertical frequency, azimuthal frequency
    and the corresponding periods

20. [4] Our backyard: the Local Group
    [4.2] Spirals of the Local Group
    The Andromeda galaxy / M33: a late-type spiral
    [5] Spiral and S0 galaxies
    [5.3] Gas motions and the masses of disk galaxies

21. Rotation Curves and Spiral Arms in Galaxies
    Decomposition of rotation curves. Two types of rotation curves.
    Dark matter in disk galaxies
    The Tully-Fisher versus the Faber-Jackson relationship
    [5.4] Spiral arms and galactic bars
    Observed spiral patterns: trailing vs. leading spirals
    Disk Dynamics and Spiral Structure
    Dispersion relation for gaseous disks
    Long waves / Short waves / Toomre stability of disks
    SWING amplifier
    Lin-Shu theory of spiral modes and WASER cycle
    Correlation of rotation curve with the type of spiral pattern:
    physical explanation of spiral galaxy classification

22. Bars as a by-product of spiral mode evolution
    Encounters and mergers between galaxies
    Gravitational lensing

23. [6] Elliptical galaxies
    [6.2] Motions of the stars
    The Faber-Jackson vs. Tully-Fisher relations
    [6.5] Galaxy clusters: the domain of elliptical galaxies
    Elliptical galaxies: nature, nurture, or merger?
    [8]Supermassive Black Holes and Active Galactic Nuclei
    early history of galaxies

24. The Universe
    [7] Large-scale distribution of galaxies
    [7.1] Observations of large-scale structure: galaxy clustering
    [7.2] Expansion of a homogeneous Universe
    [7.3] Growth of structure: peculiar motions
    clusters, walls, and voids
    [8.3] Cosmic Microwave Background Radiation (CMBR) - satellite observations.
    First observational proof of a flat spacetime in our universe:
    Boomerag and WMAP experiments
    The universe in 21st century:

Einstein's cosmological constant Lambda returns (Dark Energy)