Master Syllabus Department of Physics and Astronomy



PHYC 606 Stellar Evolution and Black Holes Workshop for Teachers

Course Description

This course is a lecture/laboratory-oriented course that introduces middle and high school teachers to the basic principles of stellar properties and stellar evolution. Fundamental laws are reviewed in the context of white dwarfs, neutron stars, pulsars, and black holes. It also provides practical applications through hands-on experiences in how stellar properties are determined. (3 credit hours)

Prerequisite: ASTR 604 or PHYC 604 or permission of the Instructor.

Course Objectives

1st Day:

Properties of Stars:

Describe the observations necessary for the determination of basic physical properties of stars such as mass, temperature, luminosity, chemical composition, sizes and motions;

Draw and describe the H-R diagram and its value for its playing physical properties of stars and in expanding our knowledge about stellar sizes and distances;

List the classes of binary stars and state the criteria for determining membership in each;

Draw, label and describe the mass-luminosity relation and specify limitations on its applicability;

Identify the physical property normally thought to control the life cycles of stars and planets;

List and describe the most important energy sources for stars.

2nd Day:

Stellar Evolution:

Describe the assumptions upon which theoretical calculations of stellar models are based;

Describe what a static stellar model is and what observational evidence exists to verify such models;

List the major types of circumstellar gas and dust clouds and indicate the stage of stellar evolution associated with each;

Describe the observational evidence that supports the existence of general interstellar material;

Describe how static stellar models are used to trace stellar evolution and indicate the logical endpoint of such predictions;

State the Russell-Vogt theorem and explain what it tells astronomers about stellar evolution;

Describe how star clusters help to verify and extend the predictions of the theoretical evolutionary models of stars;

List problem areas still to be solved before our theoretical predictions can be fully accepted;

List the end phases of stellar evolution and identify the physical variable that determines the ultimate end state of stellar evolution.

3rd Day:

Describe the assumptions upon which theoretical calculations of stellar models are based;

Describe what a static stellar model is and what observational evidence exists to verify such models;

List the major types of circumstellar gas and dust clouds and indicate the stage of stellar evolution associated with each;

Describe the observational evidence that supports the existence of general interstellar material.

4th Day:

Describe how static stellar models are used to trace stellar evolution and indicate the logical endpoint of such predictions;

State the Russell-Vogt theorem and explain what it tells astronomers about stellar evolution;

Identify the physical property normally thought to control the life cycles of stars and planets;

Describe how star clusters help to verify and extend the predictions of the theoretical evolutionary models of stars;

List and describe the most important energy sources for stars and identify the stage of stellar evolution associated with each stage;

List problem areas still to be solved before our theoretical predictions can be fully accepted;

List the end phases of stellar evolution and identify the physical variable which determines the ultimate end state of stellar evolution.

5th Day:

Describe why black holes were theoretically predicted to exist;

List the three measurable properties of a black hole;

Describe the observational status of stellar mass black holes;

Explain the link between X-ray sources and black hole candidates;

Describe the significance of the event horizon, the photon sphere and the Hawking time for a black hole;

Describe the peculiar characteristics of quasars and indicate how black holes are related to such objects;

List examples of active galactic nuclei that may contain supermassive black hole.

Course Rationale

This course is designed to introduce teachers in middle and high school teachers how to describe the properties of black holes and other interesting astrophysical objects in the context of modern astrophysical theory and the process of observational verification.

Course Content, Format, and Bibliography

Content

Course Topics	
1. Properties of Stars	6. Early Stages of Star Formation
2. Types of Binary Stars	7. Middle Stages of Star Formation
3. Hertzsprung Russell Diagram	8. Death of Stars
4. Stellar Models & Structure	9. White Dwarfs & Neutron Stars
5. Nebulae & Evidence of Star Formation	10. General Relativity & Black Holes

Format

Class meets from 7:30-11:30 and from 12:30-5:00 from Monday through Friday. On Friday, lectures are scheduled until only 11:30 am. After lunch, time will be spent for review and questions. The Final Exam will be given from 2:45 to 5:00 PM. Anyone wishing to start the evaluation and closing before 2:45 on Friday should discuss this desire with the Dr. Jordan.

All reading assignments will be taken from your textbook or will be provided. Reading assignments should be completed prior to attending class in order to make laboratory time more efficient and lectures more effective. Written assignments will be discussed in class during the week to provide feedback on your performance.

Bibliography

Stellar Evolution and Black Holes Workshop for Teachers, by Dr. Thomas M. Jordan

Foundations of Astronomy, 12th Edition by Michael A. Seeds and Dana Backman, Brooks-Cole/Cengage Publishing, 2013.

www.bsu.edu/physics