

PHYC 602 Observational Astronomy Workshop for Teachers

Course Description:

Lecture/laboratory-oriented course that prepares middle and high school teachers to explain celestial events, plan observing sessions, and use star charts and planetaria-type computer software. Introduces image acquisition and software to extract meaningful data. (3 credit hours)

Prerequisite: Middle-School/High School Teachers

Not open to who have credit in ASTR 602

Course Objectives:

1st Day:

Identify the following objects in the planetarium without the aid of a star chart: Polaris, Big Dipper, Little Dipper, Arcturus, Bootes, Spica, and Virgo;

Define without assistance the following terms: ecliptic, Zodiac, equinox, solstice, apparent magnitude, absolute magnitude, local celestial meridian, zenith, and nadir;

Describe the equatorial and horizon coordinate systems in terms of their fundamental and secondary reference planes, poles and coordinates;

Use celestial globes to locate celestial objects in the night sky and to determine their name, designation, or equatorial coordinates;

Use an SC1 or SC2 constellation chart to locate celestial objects in the planetarium or the night sky and to determine their names, designation, or equatorial coordinates;

Use an SC1 or SC2 constellation chart to determine the sidereal time given either local time or standard time and identify the constellations visible at that time;

Describe the orientation of the Equatorial Coordinate System for an observer at a given latitude;

Determine brightness ratios for celestial objects when given their magnitudes.

2nd Day:

Identify the following objects in the planetarium without the aid of a star chart:

Regulus, Leo, Corona Borealis, Hercules, Draco, Antares, and Scorpius

Define without assistance the following terms: local time, zone time, apparent solar time, mean solar time, sidereal time, transit, local celestial meridian, circumpolar;

Describe in the planetarium how objects in different regions of the sky appear to move as a result of the earth's rotation (diurnal motion);

Use a Graphic Time Table to determine the local and zone times of celestial events;

Describe the difference between apparent solar time and mean solar time and why this difference exists;

Define without assistance the following terms: refraction, diffraction, dispersion, focal length, and aperture;

Identify the primary parts of most common telescopes when given a telescope;

Identify two types of telescope mounts and describe the advantage of each;

Describe quantitatively the effect of focal length and aperture on the image size, light gathering power, resolving power, magnification plate scale and field of view of a telescope.

3rd Day:

Identify the following objects in the planetarium without the aid of a star chart: Vega, Lyra, Deneb, Cygnus, Altair, Aquila, and Ophiuchus;

Explain with the aid of diagram how lunar phases are solely determined by relative positions of the Earth, Moon and Sun and draw the phases of the Moon;

Define without assistance the following terms: sidereal month, synodic month, node, line of nodes, syzygy, lunar eclipse, solar eclipse, umbra, and penumbra;

List and describe the differences between the three types of lunar eclipses and the three types of solar eclipses;

Use a Graphic Time Table and the Field Guide... to plan an observing session for a given date;

Be able to define and draw the various planetary configurations and identify the phases associated with each configuration;

Define without assistance the following terms: comet, asteroid, meteoroid, meteor, meteorite, meteor shower and radiant;

4th Day:

Point out and name the 21 bright stars and constellations listed on the previous three days;

Define without assistance the following terms related to IBM/PCs: bit, byte, Kb, Mb, Gb, Tb, memory, ram, floppy disk, hard drive;

Define without assistance the following terms related to CCD cameras: pixel, ADU, bias frame, dark frame, flat field frame, image or light frame, blooming, readout time;

Define without assistance the following terms related to astronomical imaging: sensitivity, spectral response, reciprocity failure, and linear detector;

Acquire and process CCD images of laboratory and astronomical objects;

List the basic applications of CCD images and provide examples of each;

Briefly describe the three possible components of an image file and discuss how the size is related to the A to D converter and the array size;

List the number of bytes required to store 1) an ASCII character code, 2) an integer and a decimal or floating point number in a computer or on a floppy disk;

List the basic file formats used for CCD images and identify the appropriate file extension;

Explain what bias is and how one can obtain a measure of the bias;

Describe how and when bias frames are obtained, how they are processed and explain why;

Explain what dark counts are and how one can obtain a measure of the dark count rates;

Describe how dark frames are obtained and how they are processed and explain why;

Explain what a flat field is and how one can obtain a measure of the flat field;

Describe how and when flat field frames are obtained and how they are processed and explain why;

List the sources of unwanted noise present in a typical CCD image frame.

5th Day:

Point out and name the 21 bright stars and constellations listed in the first three days' objectives without assistance;

Determine the proper time intervals between images used in order to search for asteroids;

Describe the steps taken to ensure image alignment between CCD images taken to detect asteroids;

Discuss the limitations on exposure times used for asteroid searches;

Determine the offsets between two CCD images and blink them to identify potential asteroids or cosmic rays;

Extract instrumental magnitudes from CCD images using the software CCDSoft and Microsoft Excel.

Course Rationale

This course has been designed to introduce teachers in Middle and High School to the terminology, resource materials, techniques and equipment used in an amateur level Observational Astronomy course. The material presented will be useful in planning and conducting astronomical observing sessions.

Course Content, Format, and Bibliography

Content

Course Topics	
1. Astronomical Nomenclature	6. Astronomical Telescopes
2. Stars and Constellations	7. Telescope Alignment
3. Celestial Coordinate Systems	8. Digital Image Acquisition
4. Time and Calendar	9. Digital Image Reduction and Calibration
5. Planetarium Software	10. Astrometry and Photometry

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 the lab manual, the *Field Guide*, 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 reviewed and discussed during the week to provide feedback on your performance in class.

Observing sessions will be held each evening in the Ball State Observatory as weather permits throughout the week and participants are encouraged to attend if possible.

Bibliography

Observational Astronomy Workshop for Teachers, by Dr. Thomas M. Jordan

A Field Guide to the Stars and Planets, 4th Edition, by Jay M. Pasachoff and Donald H. Menzel