

UNIT CONTENTS – SENIOR ASTRONOMY

UNIT 1 – ASTRONOMY & THE UNIVERSE (SCALES OF THE UNIVERSE)

7 hours (2 weeks)

UNIT CONTENT

SI Units (mass, length, time, temperature, force); Scientific Notation; Scales of the Universe (Astronomical Units, Light Year, Parsecs); Unit analysis; Indices Laws; Powers of ten and orders of magnitude; Angular measures (arcmin, arcsec); Unit circle and radian measure (converting between degrees and radians); Angular size and small angle formula; Definition of vectors and scalars; Distance, displacement, speed, velocity, acceleration, force (introduce Newton's 3 laws of motion); Definition for distance to a celestial object in parsecs; Distances in light-years.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 2 – DISCOVERING THE NIGHT SKY

7 hours (2 weeks)

UNIT CONTENT

Patterns in the sky – naked eye astronomy; Constellations & the Celestial Sphere; Diurnal motion & the Earth's rotation; Seasons; Celestial coordinates - right ascension, angle of declination, celestial equator, meridian & north & south celestial poles; The ecliptic and ecliptic plane; Equinoxes & solstices; Sidereal period (Earth); Zenith, & azimuth; Circumpolar stars; Precession; Solar clock – apparent solar day, mean solar day (mean sun); Time zones, UTC & sidereal time; Calendar – sidereal year & tropical year.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 3 – ECLIPSES

7 hours (2weeks)

UNIT CONTENT

Phases of the moon; Synchronous rotation; Sidereal, synodic & lunar months; Lunar eclipse – partial, penumbral & total; Solar eclipse – partial, annular & total; Conditions for eclipses - inclination of the Moon's orbit & line of nodes; Predicting solar eclipses; Ancient methods for predicting the distance within the solar system.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 4 – DYNAMICS OF THE SOLAR SYSTEM & FUNDAMENTAL KINEMATICS I (KEPLER'S AND NEWTON'S LAWS)

18 hours (5 weeks)

UNIT CONTENT

Early geocentric models; Direct and retrograde motion; The Ptolemaic System (epicycles to explain retrograde motion); Heliocentric models; Inferior and superior planets; Elongation, opposition and conjunction; Sidereal & synodic periods (planets); Calculating sidereal periods (inferior and superior); Non-mathematical representation of an ellipse; Elliptical orbits and Kepler's 1st, 2nd, and 3rd laws; Calculations using Kepler's 3rd law; Phases of Venus (proof of heliocentric solar system); Newton's laws of motion and law of universal gravitation; Newton's form of Kepler's 3rd law; Tidal forces on the Earth and the Moon; Gravitational potential energy; Linear kinetic energy; acceleration due to Gravity.

ASSESSMENT OPPORTUNITY

Supervised Written (Examination) – Units 1 to 4 Parts A & B. Duration 2 hrs. 20 mins total.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 5 – PROPERTIES OF LIGHT

21 hours (6 weeks)

UNIT CONTENT

Electromagnetic waves & electromagnetic spectrum (Inc visible spectrum - dispersion); Interference patterns (Young's double-slit experiment); Temperature (scales) – radiation from heated bodies; Blackbody radiation & blackbody curves (dominant frequency); Einstein's photoelectric effect (with graphical analysis and derivation of Planck's constant); Einstein's energy equations; Radiation Laws (Wien's law, energy flux, bolometric flux, luminosity); Wave-particle duality; Definition of linear momentum; De Broglie wavelength; Emission spectra & Spectroscopy – identifying elements through unique spectral lines; Kirchhoff's laws of Spectra; Light scattering; Atomic structure; Bohr's model for hydrogen – Quantum orbitals and series (Balmer, Lyman & Paschen); Hydrogen atom and the Balmer series; Ionisation; Doppler effect - blue-shift & red-shift; Relativistic equation for large z .

ASSESSMENT OPPORTUNITY

CLEA computer simulation activity "Spectral Analysis and Classification of Stars" and exercise questions.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 6 – ROTATIONAL MECHANICS I

7 hours (2 weeks)

UNIT CONTENT

Linear and angular velocities; Linear and angular momentum; Torque; Newton's 1st law and rotational inertia; Formulae for rotational inertia of different shaped bodies; Conservation of angular momentum; Linear and rotational kinetic energy.

ASSESSMENT OPPORTUNITY

Supervised Written (Examination) – Units 5 & 6 Parts A & B. Duration 2 hrs. 20 mins total.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 7 - OPTICS & TELESCOPES

18 hours (5 weeks)

UNIT CONTENT

Refracting Telescopes – Lenses; Light passing through a medium - speed of light in different mediums; Refraction and refractive indexes; Snell's Law; Lenses and refracting telescopes (objective & eyepiece); Focal length of lenses; Chromatic aberration; Light-gathering power; Magnification; Limitations of refractors; Reflecting Telescopes – Mirrors; Law of reflection; Concave, convex and parabolic mirrors (ray diagrams, identifying and locating focal points schematically and mathematically); Primary and secondary mirrors; Resolving power – angular resolution; Spherical aberration – methods of correction; Effects of the atmosphere; Light pollution & refraction through differing density air masses (twinkling); Limits to angular resolution – atmospheric & diffraction; Diffraction-limited angular resolution; Active & adaptive optics; Interferometry; Imaging – Charge-Coupled Devices (CCDs); Spectrographs (prism & diffraction gratings); Hubble Space Telescope; Non-optic Astronomy; Radio telescopes & astronomy; Limits to angular resolution – Very Large Array & Very Large Baseline Interferometry (VLBI); Optical & radio window; Infra-red, ultra-violet, X-ray and gamma-ray telescopes & astronomy.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 8 – PLANETOLOGY

22 hours (6 weeks)

UNIT CONTENT

Overview of Solar System; Broad comparison – inner (Terrestrial) and outer (Jovian) planets; Comparing planetary orbits; Characteristics of the planets – Physical properties; Average density of the planets; The Solar Systems seven giant satellites; Spectroscopy – determining the chemical composition of the planets; Determining atmospheric composition; Determining surface composition; Temperature and composition; Effects of temperature on atmospheres; Kinetic energy of atmospheric molecules; Escape velocities of planets; Asteroids; Belt asteroids; Stable Lagrange points; Trojan asteroids; Apollo asteroids; Orbits of known asteroids; Kirkwood gaps in the asteroid belt; Kuiper belt & Oort cloud; Trans-Neptune objects (Kuiper belt); Comets – composition, origin, nuclei & tails; Orbit of comets – long & short period; Comet debris; Craters – origin, comparison & measures of geologic activity; Planetary magnetic fields; Magnetic field lines (flux \mathbf{B}) – bar magnet; Magnetic field strength (flux density \mathbf{B}); Dynamo – induced magnetic field through conduction of electricity; Magnetometers; Comparison of magnetic fields; Three key properties of the Solar System (size & composition terrestrial & Jovian planets, directions & orientations of planetary orbits and size of orbits – Terrestrial Vs Jovian); Abundance of chemical elements; Origin of the elements; Radioactive elements – revealing the age of the Solar System by radioactive dating; Solar nebula; Tidal hypothesis Vs. nebular hypothesis; Proto-sun & proto-planetary disk (proplyd); Accretion of planetesimals; Temperature distributions in the solar nebula; Chemical differentiation & Chondrules; Core accretion model; Disk instability model; Modern Laplacian theory; Extra-solar planets – methods of detection (astrometric, radial velocity & transit).

ASSESSMENT OPPORTUNITY

Comparative Essay – Theories on the Formation of the Solar System.

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

UNIT 9 – OUR NEAREST STAR, THE SUN

11 hours (3 weeks)

UNIT CONTENT

The Sun as a thermonuclear powerhouse; Thermonuclear fusion; Mass defect and binding energy; Einstein's mass-energy equation; Hydrostatic & thermal equilibrium; Conduction, convection and radiative diffusion; Theoretical model of the Sun; Solar neutrinos; Solar atmosphere (Photosphere, Chromosphere, Corona); Limb darkening; Solar granulation; Transition zone; Solar wind; Sunspots, filaments & prominences; Solar rotation; Effects on sunspots by magnetic fields; Plasma; Coronal holes, solar flares & coronal mass ejections.

ASSESSMENT OPPORTUNITY

CLEA computer simulation and work-booklet "Solar Rotation"

UNIT CONSOLIDATION OPPORTUNITIES

Online Quizzes

ADDITIONAL ASSESSMENT OPPORTUNITIES

☀ "Eyes on the Sun" Solar Imaging and Processing unit

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