International Space Olympiad 2025

SYLLABUS

PRELIMINARY LEVEL

The Earth

- Structure of the atmosphere and its layers
- Earth's orbit and axial tilt
- Daily phenomena: Rising and setting of the Sun and other stars
- Yearly phenomena: Seasonal variations

The Moon

- Phases of the Moon
- Tides and their relation to Moon and Sun
- Formation of the Moon

The Solar System and Beyond

- Sun and the planets – key features
- Asteroids, comets, and dwarf planets
- Our nearest stars
- The Milky Way galaxy
- Local Group of galaxies
- Large-scale structure of the Universe

Measurements in Astrophysics

- Distance measurements: Parallax, Standard candles
- Velocity measurements: Doppler effect, red and blue shifts
- Chemical composition: Spectroscopy and dispersion of light

INTERMEDIATE LEVEL

Astrophysics of Stars

- Sun: Energy production (nuclear fusion), structure, and life cycle
- Stellar evolution: From birth to death
- High-mass star evolution: Supernovae, neutron stars, and black holes

Exoplanets

- What are exoplanets?
- Detection methods: Transit method, Radial velocity, Direct imaging, Microlensing
- Habitable zones and types of exoplanets

Search for Extraterrestrial Intelligence (SETI)

- Possibility of life beyond Earth
- Methods of searching for extraterrestrial signals
- Technosignatures and biosignatures
- Drake Equation

Cosmology

- Hubble’s Law and the expanding universe
- The Big Bang theory

- Cosmic Microwave Background (CMB) radiation
- Dark matter and dark energy

FINAL LEVEL

Space Missions and Satellites

- Types of space missions: Fly-by, Orbiter, Impactor, Lander, Rover, Sample return, Crewed missions – with key examples (e.g., Voyager, Mars rovers, Artemis, OSIRIS-REx)
- Satellites:
    - By **orbit** (LEO, MEO, GEO, Polar, Sun-synchronous)
    - By **use** (Communication, Navigation, Weather, Scientific, Military) – with examples

Rocketry and Orbits

- Newton's Third Law of Motion and its application in rocketry
- The Rocket Equation (Tsiolkovsky's Equation)
- Types of orbits and orbital maneuvers
- Launch vehicles and propulsion types

Telescopes and Observatories

- Types of telescopes: Optical, Radio, Infrared, X-ray, Gamma-ray
- Classification based on observing wavelength and technology (reflecting, refracting, radio dishes, etc.)
- Major space telescopes (Hubble, JWST, Chandra, Spitzer, etc.)
- Ground-based observatories: VLT, ALMA, GMRT, etc.

- Gravitational wave observatories: LIGO, Virgo
- Neutrino observatories: IceCube, Super-Kamiokande
- Cosmic ray observatories: Pierre Auger, HAWC

History of Space Exploration

- General Timeline of Space Exploration
- Overview of major space agencies: NASA, ESA, ISRO, Roscosmos, CNSA, JAXA
- Space technology spinoffs and their applications on Earth

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