IASS Educational Board Members

**Mentor**
**Hon. Prof Suresh Naik**
Director SN Space Education Center, Pune. India.
Mentor Cub Sat Mission,
Executive Mentor PMI Deccan India Ch.,
Chairman International Space Society, India.
Ex-Group Director ISRO.

**Course Coordinator**
Mr. Sachin Kulkarni
AMIIIE (Industrial Engg.)

**Course Faculty**
Gyandeo Mishra
B.Tech (Instrumentation Engg.)

Shashank Dhone
MSc. (Chemistry)
Overview

Astronomy, space science and astrophysics allow us to see the universe and our place in it. Through studying these subjects, mankind has continually enlarged its horizons and explored the cosmos. The subjects continually evolve and change every year based on discoveries by researchers around the world.

Astronomy is one of the oldest sciences, practised by most of the world's ancient civilisations, and one of the most modern, relying for many recent discoveries on high technology and the space programme.

It is an observational science that provides our view of the vast ranges of scales of space, time and physical conditions in the universe. Astrophysics emphasises the underlying physical concepts of the stars and galaxies, which make up the universe, providing an understanding of the physical nature of bodies and processes in space and the instruments and techniques used in modern astronomical research.

Space is often referred to as the final frontier of exploration by mankind. Space exploration and observations depend to a large extent on satellites and other forms of space probes. Designers of space equipment need a good understanding of physics and astrophysics, together with specialised engineering skills.

Programme Specification

1) Awarding Institution / Body | IASS
2) Location of Delivery | IASS Campus
3) Level of Course | Level I
4) IASS Code | IASS - L1
5) Course Duration | 1 month / 20 Days / 2hrs (5 days in a week)
| 2-1/2 Months / 20 Days / 2hrs (2 days in a week)
6) Course Fees | Rs.6300/-
7) Course timing | 6:00PM to 8:00PM

Course structure

Modules of Theory
Experiments
Practicals (Including Telescope Making)
Sky watch

Astronomy Study Is Not Only For Brilliant Minds It Makes Your Mind Brilliant !!!
Aims of the programme

- To provide an academically rigorous programme of Astronomy education suitable for astronomy enthusiasts with or without previous formal qualifications.
- To provide a quantitative understanding and knowledge of the physical and mathematical concepts underlying astrophysical processes.
- To provide a broad balance of subject knowledge and skills.
- To develop students’ ability to think analytically and critically about scientific ideas in order to develop logical arguments and draw conclusions.
- To provide the opportunity to develop skills and techniques used in astronomy which have wider applications (eg independent working, scientific problem solving, data analysis, preparation of scientific reports and use of IT, communication of scientific ideas.)
- To enable students to apply the advanced tools of maths and physics to solve problems in astrophysics situations.
- To develop the students’ investigative skills either through group activities or independent research using literature sources and/or subject databases.
- To provide a suitable foundation for further study in Astronomy.

Learning Outcomes, Teaching, Learning and Assessment Methods

A. Knowledge and Understanding

A1. Describe and explain the structures of the universe and the processes that take place within it in terms of the underlying physical laws, including some at (or informed by) the forefront of astronomy.
A2. Solve a broad range of problems in astronomy.
A3. Discuss and quantify uncertainties and limitations of astronomical theory.
A4. Discuss the techniques of observational astronomy and their limitations.

B. Subject-specific skills

B1. Design and implement astronomical observations.
B2. Use investigative techniques to retrieve astronomical information from on-line/library data sources.
B3. Analyse and process astronomical data taking into account the uncertainties.
B4. Plan and prepare a substantial scientific report on a topical astronomical subject.
B5. Use a range of mathematical techniques and physical laws to solve problems.

C. Thinking Skills

C1. Review and analyse information in a critical way from a variety of sources (including scientific papers).
C2. Formulate problems in precise terms and think analytically and critically about scientific ideas in order to develop logical arguments and draw conclusions.
C3. Synthesise different strands of a theory or problem to produce a solution.
C4. Plan and implement an investigation individually and within a group environment. Critically analyse the outputs and evaluate their significance.

D. Other skills relevant to employability and personal development

D1. Use written communication skills effectively.
D2. Develop numerical skills.
D3. Work independently to plan and manage own time to achieve specific objectives.

Teaching, Learning and Assessment Methods

Course Notes linked to recommended textbook with worked examples, self-test questions and solutions. Classroom tutorials and discussions.
Feedback to students on assessed work, together with model answers to assessed questions.
Continuous assessment via course works including:
Questions Sheets with both mathematical and conceptual problems, scientific essay.
CONTENTS

LEVEL - 1

L101  Introduction to Astronomy
L102  Celestial Sphere
L103  Universe
L104  Solar system
L105  Earth
L106  Sun
L107  Comets, Asteroids, Meteors
L108  Stars
L109  Basic Physics
L1010 Light
L1011 Telescope
L1012 Galaxies
L1013 Cosmology
L1014 Exoplanets
**Module Name**
Introduction to Astronomy

**Module Code**
IASS - L1

**Module Number**
1

**Module approval Date**
25 / 10 / 2018

**Total Marks**
10

**Duration**
2 Hrs.

**Location of study**
IASS Campus

---

**Learning objectives :**

1. Provide an introduction to astronomy, suitable for people with little prior knowledge of the subject and with a limited background in physics and maths.
2. Provide an understanding of the physical laws as applied to the Universe.
3. Provide an introduction to aspects of observational astronomy.
4. Develop elementary problem solving skills.
5. Provide the opportunity to develop skills and techniques used in astronomy, which have wider applications (these include data analysis, preparation of scientific reports)

---

**Module Syllabus**


---

**Reference books**

4) Source Book on Space Science – Samuel Glastone.
5) Fundamental of Astronomy and Astrophysics – Michael Seed.
**Learning objectives:**

1) To Understand the techniques of Observatinal astronomy.
2) To understand the Ecliptic and Galactic system of co-ordination.
3) To learn the time calculations.
4) To learn how to locate stars
5) Understanding of parallax.

**Module Syllabus**

**Celestial Sphere and Time and Mean Position of stars**

Constellations and nomenclature of stars. The cardinal points and circles on the celestial sphere. Equatorial, ecliptic and galactic system of co-ordinates. Spherical triangle and related problems. Twilight, Seasons, Sidereal, Apparent and Mean solar time and their relations. Equation of time. Calendar. Julian date and heliocentric correction. Effects of atmospheric refraction, aberration, parallax, precession, nutation and proper motion on the coordinates of stars

**Reference books**

2. A.E.Roy: Orbital Motion.
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Universe</th>
<th>Module for</th>
<th>Level I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>3</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>10</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>1</td>
<td>Duration</td>
<td>2 Hrs.</td>
</tr>
</tbody>
</table>

* Learning objectives:

1) Understand of physical laws & concepts applied to universe
2) To learn about size of universe & other characteristics
3) To understand different theories regarding origin, process & end of universe

* Module Syllabus

Universe
- origin, components of universe, scale of universe, fate of universe

* Reference books

The Structure of Universe – Jayant Naralikar.
Dynamic Astronomy - Robert T. Dixon.
Astronomy – Robert H. Baker
Introductory Astronomy and Astrophysics – Zeilik and Greogary
G. Abell: Exploration of the Universe
The Structure of Universe – Jayant Naralikar.
* Module Name: Solar System
* Module Code: IASS - L1
* Module Number: 4
* Module approval Date: 25 / 10 / 2018
* Total Marks: 10
* Module Delivery: Classroom
* Location of study: IASS Campus
* Duration: 2 Hrs.

* Learning objectives:
- Provides an introduction to the Solar System complementing stellar and galactic work
- Introduce students to images and results from recent space research and exploration.
- Develop students’ research skills

* Module Syllabus:
Formation of solar system, sun, planets and their moons, earth, position of solar system in milky way, motion of solar system

* Reference books:
K.d. abhyankar: Astrophysics Of The Solar System.
Our Solar System By A W Joshi And N Rana
Fundamentals Of Astronomy By Whitten & Popoff
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Earth</th>
<th>Module for</th>
<th>Level I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>5</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>10</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>2</td>
<td>Duration</td>
<td>4 Hrs.</td>
</tr>
</tbody>
</table>

* Learning objectives:

1) To learn more about Earth as a planet.
2) To understand physical laws and concepts as applied to Sun, Earth system.
3) To understand Earth, climate and seasons
4) To learn about Earth interior

* Module Syllabus

The Earth as a planet: its atmosphere, surface, and interior. Origin, structure, and evolution of the atmosphere

– including man made influences Humanities interaction with their planet. Global warming

* Reference books

3. Our Solar System
4. Fundamentals Of Astronomy By Whitten & Popoffm By A W Joshi And N Rana
**Module Name** | Sun | Module for | Level I
---|---|---|---
**Module Code** | IASS - L1 | Module Number | 6
**Module approval Date** | 25 / 10 / 2018 | Total Marks | 10
**Module Delivery** | Classroom | Location of study | IASS Campus
**Total Lectures** | 2 | Duration | 4 Hrs.

* Learning objectives :

1) Introduction to aspects of observational solar astronomy including ways in which our sun (Variable Star) affects Earth's environment in space & climate.
2) Provide the opportunity to develop skills & techniques used in solar astronomy.
3) To study energy of sun, Reactions, temperatures in various regions.
4) To study about sun's core & its dynamics

* Module Syllabus

Sun's place in Universe; birth, life and death of the star; characteristics of the Sun; how we observe the Sun from space today
The inferno in the solar core: nuclear fusion; solar neutrinos and SNP; detection of solar interior oscillations: basic techniques in helioseismology; solar rotation and the Best Model, Sun Solar flares; coronal mass ejections; predicting solar storms and their effect on space weather

* Reference books

1) Fundamental of Astronomy and Astrophysics – Michael Seed.
2) Introductory Astronomy and Astrophysics – Zeilik and Gregary.
3) Astrophysics (Stars & Galaxies) – K. D. Abhyankar.
4) Stars, Life, Death and Beyond – A. K. Kimbhavi and Jayant Naralikar.
5) Our Solar System – A. W. Joshi and N. Rana.
### Module Information

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Comets, Asteroids, Meteors</th>
<th>Module for</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>7</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>10</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>1</td>
<td>Duration</td>
<td>2 Hrs.</td>
</tr>
</tbody>
</table>

### Learning Objectives:

1. To study nature & composition
2. Their motion & mechanics
3. Discovery & origin
4. Orbits

### Module Syllabus


### Reference Books

1. K.S.Krishnaswamy: Physics of Comets
**Learning objectives:**

1) Origin, Formation & evolution
2) Classification
3) Life cycle of stars
4) Solar astrophysics
5) Stellar dynamics

**Module Syllabus**


**Reference books**

1. M. Schwarzschild: Stellar Evolution
2. R. Kippenhahn A. Weigert: Stellar Structure and Evolution
3. Dina Prialnik: An Introduction to the Theory of Stellar Structure and Evolution
5. S. Chandrasekhar: Stellar Structure
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Basics Physics</th>
<th>Module for</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>9</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>15</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>2</td>
<td>Duration</td>
<td>4 Hrs.</td>
</tr>
</tbody>
</table>

**Learning objectives:**

1) To understand nature of matter on macro and micro level.
2) To understand Laws of nature.
3) To understand celestial mechanics.
4) To learn and grasp general theory of relativity.
5) To learn basics of ray optics.

**Module Syllabus**

Basic physics: statics, kinematics, Newton's laws and dynamics, conservation laws, work and energy, oscillatory motion, systems of particles, and rigid body rotation. Atomic structure, Spectroscopy, Ray Optics. Possible additional topics are special relativity and thermodynamics.

**Reference books**

**Module Name** | Light | **Module for** | Level I
---|---|---|---
**Module Code** | IASS - L1 | **Module Number** | 10
**Module approval Date** | 25 / 10 / 2018 | **Total Marks** | 10
**Module Delivery** | Classroom | **Location of study** | IASS Campus
**Total Lectures** | 2 | **Duration** | 4 Hrs.

*Learning objectives:*

1) To study nature & properties of light
2) Different laws of physics related to light
3) Study of light in space
4) Study of spectral lines of celestial objects

*Module Syllabus*

wave properties, intensity, reflection, refraction, spectrum, lens, magnification, diffraction, resolution, interferometer, reflection gratings, polarization, spectral lines

*Reference books*

**Module Name**

Telescope

**Module for**

Level I

**Module Code**

IASS - L1

**Module Number**

11

**Module approval Date**

25 / 10 / 2018

**Total Marks**

10

**Location of study**

IASS Campus

**Total Lectures**

2

**Duration**

4 Hrs.

---

**Learning objectives:**

1) Study about structure & design of telescope  
2) Types of telescopes  
3) Study of space telescope  
4) History of telescope

---

**Module Syllabus**

Galilion, Newtonian, Cassegranian, Hubble space telescope, magnifying power of telescopes, resolving power of telescopes, spectroscope (prism, grating), UV, IR astronomy

---

**Reference books**

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Galaxies</th>
<th>Module for</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>12</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>10</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>1</td>
<td>Duration</td>
<td>2 Hrs.</td>
</tr>
</tbody>
</table>

* **Learning objectives:**

Provide a broad introduction to galaxies, building on the prerequisite modules. Its approach is quantitative without taking a highly mathematical approach.
- Provide students with an understanding of the location of our Galaxy in the universe the characteristics of other types of galaxies.
- Enable students to carry out estimates of physical properties of galaxies based on their analysis of observational data.
- Provide a broad overview of observations and how observations with new instruments in different wavebands may answer questions about galaxy evolution in the coming years.
- Provide practice in transferable skills relevant to communicating scientific concepts.

* **Module Syllabus**


* **Reference books**

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Cosmology</th>
<th>Module for</th>
<th>Level I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Code</td>
<td>IASS - L1</td>
<td>Module Number</td>
<td>14</td>
</tr>
<tr>
<td>Module approval Date</td>
<td>25 / 10 / 2018</td>
<td>Total Marks</td>
<td>10</td>
</tr>
<tr>
<td>Module Delivery</td>
<td>Classroom</td>
<td>Location of study</td>
<td>IASS Campus</td>
</tr>
<tr>
<td>Total Lectures</td>
<td>1</td>
<td>Duration</td>
<td>2 Hrs.</td>
</tr>
</tbody>
</table>

*Learning objectives:*

- Provide an introduction to cosmology, suitable for people with little prior knowledge of the subject and with a limited background in physics and maths.
- To provide an understanding of the physical laws as applied to the Universe.
- To provide an introduction to basic concepts in Cosmology.
- To develop elementary problem solving skills.
- To provide the opportunity to develop skills and techniques used in astronomy, which have wider applications (these include problem solving and preparation of scientific essays).

*Module Syllabus*

The expanding universe. Cosmological models: Big Bang and Steady State models. Dark matter and Dark energy.

*Reference books*

1. Facts and speculations in cosmology., Jayant V. Narlikar & Geoffrey Burbidge - Cambridge
2. An Introduction to Cosmology., Jayant V. Narlikar - Cambridge
* Learning objectives:

1) To study planet detection techniques
2) To study of exoplanets composition theorier & possibilities & prediction techniques
3) How to derive conclusions related to exoplanet conditions. Such as chemical compositions, planetary atmosphere, orbital motion etc.,

* Module Syllabus


Search for terrestrial planets: detection techniques, searching for planetary atmospheres and chemical composition. Space missions and ground-based surveys. Signatures of appropriate biochemistry

* Reference books

1. Exoplanets and Alien Solar Systems by astrophysicist Tahir Yaqoob, Ph.D.
**Experiments and Practicals**

- Practical 1 - Knowing instruments
- Practical 2 - Basic understanding Earth
- Practical 3 - Properties of Sun
- Practical 4 - Sources of energy from sun
- Practical 5 - Study moon surface
- Practical 6 - Making telescope
- Practical 7 - Satellite Communication

**Practical Astronomy**

1. Identification of various great circles on the celestial sphere and important constellations using Norton's Atlas.
2. Determination of magnitude of artificial source of light and a star.
3. Observation of variable stars using a telescope.
4. Imaging the sky.
6. Astrometry of Asteroids using virtual Observatory.
7. Determining period of rotation of the sun using virtual observatory.

**Reference Books**

1. Smart: Spherical Astronomy.

* Special Career Guidance
Session after course completed.