

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with 'A' Grade

Revised Syllabus For

B. Sc. Part-II

Astrophysics

CBCS PATTERN

Syllabus to be implemented from

June, 2019 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR.
CBCS Syllabus with effect from June, 2019
B. Sc. Part – II Semester-III
DSC-IC39- Astrophysics Paper-I
Theory: 36 Hours
Marks-50 (Credits: 02)
Paper - I (Fundamentals of Astronomy)

Course Objectives:-

- To understand the basic concepts of Fundamentals of Astrophysics and Astronomy.
- Elucidate the Nature of Light and Message of the Star Light , basic tools of Astronomers, stellar evaluation, theories of star, galaxies, milky way galaxy ,cosmology , the Solar system , Sun, fluids, hydrodynamics ,electrodynamics , and magneto hydrodynamics.
- Aim to give the student an in-depth understanding of the principles and methods of astrophysics, and the skills to apply this understanding to a range of theoretical, observational and practical problems, at a level appropriate for a professional scientist.

UNIT-I : History of Astronomy and Apparent Luminosity of Stars:- (10)

Babylonian astronomy, Greek astronomy, Ptolemy's astronomical work, Copernican heliocentric theory, Tychoonian system, Luminosity of stars, Magnitude scale, Luminosity measurement (1) Photographic method, and (2) Photoelectric method.

UNIT-II: The Sky , Calendar and Celestial coordinates (8)

The moon, Sun and stars as calendars, sidereal day, sidereal time, appearance of the celestial sphere, longitude and latitude on the earth celestial co-ordinates,

UNIT- III : The Stellar distances (10)

Measurement of terrestrial distances, distance of moon, distance of planets, Astronomical unit aberration of star light, Definition of parallax and Geocentric parallax, Trigonometric parallax of stars, light years and parsec.

UNIT-IV: Constellations, Comets, Asteroids, Meteors: (8)

Constellations – Aries, Pisces, Orion, Asterisms – summer triangle and Big Dipper (Saptarishi).
Comets, Asteroids, Meteors- Structure, chemical composition and orbits.

DSC-IC40- Astrophysics Paper-II
Theory: 36 Hours
Marks-50 (Credits: 02)
Paper - II (Fundamentals of Astrophysics)

UNIT I :

The Nature of Light and Message of The Star Light (9)

Light as an electromagnetic waves, Electromagnetic spectrum. Electromagnetic radiation from heated object, Doppler shift and its applications, Atomic spectra-emission and absorption spectra (Fraunhofer lines), Stellar spectra, Classification of stellar spectra.

UNIT II:-

Basic Tools of Astronomers (9)

Optical telescopes-Galilean, Newtonian, Cassegranian, Hubble space telescope, Magnifying power of telescope, Resolving power of telescope, Spectroscope (prism, grating), UV, IR, Radio, X-Ray and Gravitational waves astronomy.

UNIT III :

Stellar evaluation (9)

Birth of a star, maturity of a star, ageing of stars, death of a star , supernova explosion, pulsars and black holes.. Hertzsprung-Russell (H-R) diagram- white and red dwarfs, electron in a white dwarf, Chandrasekhar limit, Neutron stars

UNIT IV:

Theories of star (9)

Spectral classification of stars, O,B,A,F,G,K,M., Nuclear Reactions in stars, Luminosity of star, Photon diffusion time, luminosity of star, gravitational potential energy of a star, internal temperature and pressure of a star.

B. Sc. Part – II Semester-IV
DSC-ID39- Astrophysics Paper-III
Theory: 36 Hours
Marks-50 (Credits: 02)
Paper - III (Galaxies, Cosmology and Solar system)

UNIT I :

Galaxies:- (12)

Components of the Universe: Introduction of Stars, Planets, Asteroids, Meteors, Comets, Galaxies, Formation of galaxies, Types of galaxies-Elliptical, Spiral, Barred spiral, irregular, Hubble tuning fork diagram, Peculiar galaxies, Radio galaxies, Seyfert galaxy, Quasars.

UNIT II:-

Milky Way galaxy:- (6)

Shape of the galaxy, interstellar medium and molecules, Radio emission from interstellar carbon monoxide, clusters of stars, Galactic clusters.

UNIT III :

Cosmology :- (6)

The expanding universe, Big Bang universe , the steady state cosmology and oscillating universe, Hubble law.

UNIT IV: (12)

The Solar system

Origin of the solar system and planets, Basic structure of Sun -Sun's interior, the photosphere, the solar atmosphere (chromospheres and corona). Sunspots, Sun's rotation and Solar magnetic field, Explanation for observed features of sunspots , Planetary properties and quick facts of Mercury, Venus, and Mars. Moon - different theories of the moon , Structure of the moon and its quick facts

B. Sc. Part – II Semester-IV
DSC-ID40- Astrophysics Paper-IV
Theory: 36 Hours
Marks-50 (Credits: 02)
Paper - II (Cosmic Electrodynamics)

UNIT-I :

Fluids **(9)**

Perfect Fluid: Equation of state, equation of motion, TOV equation, stars of uniform density, limit of mass to radius ratio. Basic equations of fluid mechanics, viscosity, gas dynamics, waves and instabilities, turbulence, orbit theory, properties,

UNIT-II :

Electrodynamics **(9)**

Scalar electric potential(ϕ), Vector magnetic potential(\mathbf{A}), Poisson's and Laplace's equation, Maxwell's equation in vacuum, Electromagnetic waves in vacuum- wave equation and wave velocity, Scattering of light, scattering cross section, Thomson's and Rayleigh scattering, explanation for blue color of the sky, red color of sunset and sunrise.

UNIT-III :

Magneto hydrodynamics **(9)**

Motion of charged particle in electromagnetic field, Ideal hydro magnetic equation, Characteristics of plasma in magnetic field - Diffusion and freezing effect, Magnetohydrodynamic equation -magnetic pressure and magnetic tension, confinement of plasma

UNIT-IV :-

Hydrodynamics **(9)**

Equation of continuity - conservation of mass, Ideal fluid and Euler's equation of motion, Navier-Stokes equation for viscous fluid.

Reference Books:

- 1) Astronomy : Fundamentals and Frontiers – Jastrow & Thomson.
- 2) Dynamic Astronomy - Robert T. Dixon.
- 3) Astronomy – Robert H. Baker.
- 4) Fundamental of Astronomy and Astrophysics – Michael Seed.
- 5) Introductory Astronomy and Astrophysics – Zeilik and Greogary.
- 6) Moons and Planets – William K. Hartmann.
- 7) Our Solar System – A. W. Joshi and N. Rana.
- 8) The Structure of Universe – Jayant Naralika.
- 9) Astrophysics (Stars & Galaxies) – K. D. Abhyankar
- 10) Stars, Life, Death and Beyond – A. K. Kimbhavi and Jayant Naralika.
- 11) Fluid Mechanics - L. D. Landau and E. M. Lifshitz.
- 12) Classical Electrodynamics – J. D. Jackson.
- 13) Cosmic Electrodynamics – J. H. Pidington.
- 14) Fluid Dynamics – Rutherford.
- 15) An Introduction to Stellar Structure – S. Chandrashekher.
- 16) Electrodynamics–David Griffiths.
- 17) Elements of plasma physics - S. N. Goswami.
- 18) Astronomy: A Physical Perspective - Marc L. Kutner.
- 19) Exploring the universe- W.M. Protheroe, E.R. Capriotti, G.H. Newsom
- 20) An introduction to Cosmology- Jayant Vishnu Narlikar
- 21) Text book on Spherical Astronomy- W.M. Smart
- 22) Modern Physics (revised edition)- R. Murugesan, Er. Kiruthiga Sivaprasath
- 23) Spherical astronomy- M.L. Khanna
- 24) Introduction to Fluid dynamics Aitchison,
- 25) Plasma Astrophysics, Sturrock, P., Academic Press, 1967.
- 26) Fluid Mechanics, 2nd ed Landau & Lifshitz., Butterworth-Heinemann, 1998

DSC-IC and DSC-ID -Practicals**Marks-100 (Credits: 08)****List of Experiments****Group – I:**

- 1) Numerical Integration.
- 2) Numerical Differentiation.
- 3) Numerical interpolation.
- 4) Solution of ordinary differential equations.
- 5) Measurement of terrestrial distance using Sextant.
- 6) Total internal reflection in prism.
- 7) Constellation map drawings – a) Orion b) Ursa Major (Big Dipper) c) Auriga d) Taurus.
- 8) To use idea of parallax to determine large distance

Group – II :

- 1) Lummer Brothum Photometer (comparison of intensities)
- 2) Spherical aberration (caustic curve).
- 3) Resolving power of telescope.
- 4) Magnifying power of telescope.
- 5) Determination of Planck's constant using LED
- 6) Goniometer: Equivalent focal length
- 7) Study of scattering of light (Diameter of Lycopodium powder).
- 8) Verification of Stefan's forth power law.

Group – III:

- 1) I-V Characteristics of solar cell and verification of inverse square law of intensity.
- 2) Velocity of sound using CRO and microphone.
- 3) Study of Lissageous figures using CRO.
- 4) D.C. Amplifier using Operational amplifier.
- 5) Measurement of Earth's magnetic field using Earth inductor.
- 6) Measurement of wavelength of given LASER source using diffraction grating.
- 7) Phase shift measurement RC network using CRO.
- 8) Study of hysteresis curve using CRO.

Group – IV:

- 1) Calibration of spectrometer.
- 2) Study of Balmer lines.
- 3) Measurement and identification of spectral lines.
- 4) Measurement of wavelength using F. P. Etalon.
- 5) Band absorption spectrum of liquid (KMnO₄ solution).
- 6) Study of solar spectrum.
- 7) Sunspots activity analysis.
- 8) Study of line absorption spectrum and measurement of temperature of flame.

Part – II : Study tour and/or Night sky observation.

Practical Examination: Each candidate has to perform a total of 4 experiments (one experiment from each group)

Practical Marks distribution:

- i) Each experiment carries 20 marks X 4 = 80
- ii) Journal = 10
- iii) Report on Part – II = 10

Course Outcomes:-

- Explain the fundamental principles that underpin theoretical and observational astrophysics and astronomy.
- Inculcate the importance of astrophysics and astronomy to the core areas of stellar astrophysics, fluids, hydrodynamics, electrodynamics magneto hydrodynamics, plasma galaxies and cosmology.
- To develop the student's competence in the application of methods of mathematics and in an astrophysical context.