

"Education for Knowledge, Science and Culture"

- Shikshanmaharshi Dr. BapujiSalunkhe

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)



Department of Physics and Astrophysics

B.Sc. Part – II,

Semester III & IV, CBCS

Astrophysics

Semester	Paper No.	Course Code	Course Title	No. of Credits
III	I	DSC-1511C1	Fundamentals of Astronomy	4
	II	DSC-1511C2	Fundamentals of Astrophysics	4
IV	III	DSC-1511D1	Galaxies, Cosmology and Solar system	4
	IV	DSC-1511D2	Cosmic Electrodynamics	4
III & IV	-	SEC-I	SEC Course I	2
	-	SEC-II	SEC Course II	2

Syllabus with effect from August, 2022

Vivekanand College, Kolhapur (Autonomous).

Department of Physics

B.Sc. II (Astrophysics)

POs

1. To develop fundamental scientific knowledge
2. To develop basic scientific and mathematical skills
3. Students should progress their vertical mobility
4. To develop required technical skills
5. Develop moral, social and ethical values
6. Able to survive in society

PSOs

1. Students should understand mathematical concepts needed for understanding Astrophysics
2. Students should understand fundamental basic theories of Space Science, Astronomy, Cosmology, Solar system etc.
3. Students should learn laboratory skills; students should take measurements in Astro Physics laboratory and analyze the measurements to draw valid conclusions
4. Students will be capable of oral and written scientific communication and will prove that they can think critically and work independently.

COs

Course I: Fundamentals of Astronomy (DSC-1511C1 Sem III)

CO₁: To understand the basic primary concept of ancient astronomical theories. To understand the knowledge of apparent luminosity of stars

CO₂: Students will demonstrate a proficiency in solving problems in Astronomy

CO₃: To understand the basic concepts of (I) Celestial objects, Celestial Sphere, Celestial Coordinates. (II) Terrestrial distances, concept of light years, distance of sun, moon and stars. (III) Identification of stars, various constellations and Comets, Asteroids and Meteors.

CO₄: To develop the critical skill in students to understand Astronomy.

Course II: Fundamentals of Astrophysics (DSC-1511C2 Sem III)

CO₁: To understand the basic primary concept of ancient astronomical theories. To understand the knowledge of apparent luminosity of stars

CO₂: Students will demonstrate a proficiency in solving problems in Astrophysics

CO₃: To understand the basic concepts of (I) Various Spectrums, Different tools of Astronomers, evolutions of stars, H-R diagram .(II) Different theories describing origin of stars , (III) To understand the laws of Astrophysics

CO₄: To develop the critical skill in students to understand Astrophysics.

Course III: Galaxies, Cosmology, solar system (DSC-1001D1 Sem-IV)

CO₁: To understand the basic knowledge about galaxies Cosmology, solar system

CO₂: Students will demonstrate a proficiency in solving problems in galaxies Cosmology, solar system

CO₃: To understand the basic concepts of (I) Cosmological theories , cosmological tests .(II) Milky-way galaxy, position of our solar system in milky way galaxy(III) Details of our solar system , theories of moon

CO₄: To develop the critical skill in students to understand applied knowledge of Galaxies, Cosmology, solar system

Course IV: cosmic electrodynamics (DSC-1001D2 Sem-IV)

CO₁: To understand the basic knowledge about cosmic electrodynamics.

CO₂: Students will demonstrate a proficiency in solving problems in cosmic electrodynamics.

CO₃: To understand the basic concepts of (I) Concepts of fluid, continuity equation, basic equation of fluid dynamics. (II) Equation of electrodynamics and magneto hydro dynamics

CO₄: To develop the critical skill in students to understand applied knowledge of cosmic electrodynamics.

VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS).
CBCS Syllabus with effect from June, 2022
B. Sc. Part – II Semester-III
DSC-1511C1-Astrophysics Paper-I
Theory: 36 Hours
Marks-50 (Credits: 02)
Fundamentals of Astronomy

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

Babylonian astronomy, Greek astronomy, Aristotle work, Ptolemy's astronomical work, Copernican heliocentric theory, Tychoonian system, Luminosity of stars, Magnitude scale, expression for luminosity ,flux and magnitude ,Luminosity measurement(1)Visual method (2) Photographic method, and (3) Photoelectric method.

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

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

UNIT- III : The Stellar distances (10 hrs)

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 hrs)

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

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CBCS Syllabus with effect from June, 2022

B. Sc. Part – II Semester-III

DSC-1511C2-Astrophysics Paper-II

Theory: 36 Hours

Marks-50 (Credits: 02)

Fundamentals of Astrophysics

UNIT I:

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

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 hrs)

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 hrs)

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 on origin of stars (9 hrs)

Nebular hypothesis ,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.

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CBCS Syllabus with effect from June, 2022

B. Sc. Part – II Semester-IV

DSC-1511D1- Astrophysics Paper-III Theory: 36

Hours

Marks-50 (Credits: 02)

Galaxies, Cosmology and Solar system

UNIT I :

Galaxies:- (12)

Components of the Universe: Introduction of Stars, Planets, Asteroids, Meteors, Comets, Galaxies, Formation of galaxies, visual morphology of galaxy, Types of galaxies-Elliptical, Spiral, Barred spiral, irregular, Hubble tuning fork diagram, Peculiar galaxies, Radio galaxies, Seyfert galaxy, Quasars.[Galaxy : Nomenclature, observation theory, Types and morphology, properties, formation and evolution, large scale structure]

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.[Appearance, size and mass , contents, structure ,formation , environment , astronomical history]

UNIT III :

Cosmology :- (6)

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

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, Structure of the moon and its quick facts.

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CBCS Syllabus with effect from June, 2022

B. Sc. Part – II Semester-IV

DSC-1511D2- Astrophysics Paper-IV

Theory: 36 Hours

Marks-50 (Credits: 02)

Cosmic Electrodynamics

UNIT-I :

Fluids

(9 hrs)

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

UNIT-II :

Electrodynamics

(9 hrs)

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 hrs)

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 hrs)

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) Our Solar System – A. W. Joshi and N. Rana.
- 3) The Structure of Universe – Jayant Narlikar.
- 4) Astrophysics (Stars & Galaxies) – K. D. Abhyankar
- 5) Fluid Mechanics - L. D. Landau and E. M. Lifshitz.
- 6) Classical Electrodynamics – J. D. Jackson.
- 7) Cosmic Electrodynamics – J. H. Pidington.
- 8) An Introduction to Stellar Structure – S. Chandrasekher.
- 9) Electrodynamics–David Griffiths.
- 10) An introduction to Cosmology-Jayant Vishnu Narlikar

Skill Enhancement Course (SEC) I
(Cosmology and Galaxies)
B.Sc. II
(Credit 2)

I. Project work regarding cosmological theories and galaxies

- Big-Bang theory
- Oscillatory theory
- Steady state theory
- Types of Galaxies

Skill Enhancement Course (SEC) II
(Cosmology and Galaxies)
B.Sc. II
(Credit 2)

I. Project work regarding solar system, solar activities and stellar evolution

- History of planets
- Sun spots, solar magnetic field, rotation of sun, interior of sun
- Protostar, dwarf star, pulsar, super nova black hole etc.

B.Sc. II Astrophysics Lab Work (Practical)
Marks-100 (Credits: 08)

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.

- There will be internal evaluation of 15 marks for each paper.
- There will be end semester theory examination of 35 marks for each paper.
- The total marks for each paper will be 50.
- There will be separate passing for internal evaluation, end semester theory examination, practical examination and Skill Enhancement Courses
- There will be compulsory sky observation or study tour visit to any nearest planetarium

Paper No.	Internal evaluation	End Semester Theory Examination	Total
I	15	35	50
II	15	35	50
III	15	35	50
IV	15	35	50

- There will be practical examination of 100 marks at the end of semester IV
- Distribution of 100 marks of practical is as below

Group I	20
Group II	20
Group III	20
Group IV	20
Journal	12
A brief report on sky observation or study tour	08
Total	100

- There will be separate examination of 100 marks for Skill Enhancement Courses (SEC's) of all three subjects together of B.Sc. II at the end of semester IV (Conducted by College Examination Cell)

Nature of Question Paper (End Semester Examination)

Instructions:

- 1) All the questions are **compulsory**.
- 2). Figures to the right indicate **full** marks.
- 3) Draw neat labeled diagrams **wherever** necessary.

Time : 2 hours

Total Marks: 35

Q:1] Chose correct alternative

- A] **FIVE** Multiple Choice Questions 5 Marks
- B] **TWO** fill in the blanks 2 Marks

Q:2] Long Answer questions (Attempt any **TWO** out of three) 16 Marks

Q:3] Short Answer questions (Attempt any **THREE** out of five) 12 Marks