Estd. 1962
"A++" Accredited by NAAC(2021)
With CGPA 3.52

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दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१–२६०९०९३/९४

SU/BOS/Science/ 65 **Date: 09 / 11 / 2022**

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of B. Sc. Part- I (Astrophysics) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 .

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **B. Sc. Part -I Astrophysics** under the Faculty of Science and Technology **as per National Education Policy 2020 .**

Sr.No.	Faculty of Science and Technology	Programme/ Course
1	**Physics**	**B. Sc. Part -I Astrophysics**

This syllabi and nature of question paper shall be implemented from the Academic Year **2022-2023** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

SHIVAJI UNIVERSITY, KOLHAPUR.

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NATIONAL EDUCATION POLICY

(NEP-2020)

Syllabus For B. Sc. Part-I

Astrophysics and SpaceScience

Syllabus to be implemented from

AUGUST, 2022 onwards

Department of Physics, Shivaji University, Kolhapur B. Sc. Part-I (Astrophysics and Space Science) Course Structure

NOTE: The following in a nutshell gives the scope and extent of each course offered. Each core theory course has two levels of teaching: Lectures and practicals.

B.Sc. I Astrophysics and Space Science (NEP-2020)				
Part I Semesters I and II				
CGPA	**S.No.**	**Course Code**	**Course Title**	**Credits**
	1	**DSC-35A**	**Fundamentals of Astronomy**	**2**
	2	**DSC-36A**	**Mathematical course for Astrophysics and Space Science**	**2**
	3	**DSC-35A**	**Introduction to Space Science**	**2**
	4	**DSC-36B**	**Experimental techniques in Astronomy**	**2**
	5	**DSCA LabI** **DSC A LabII**	**Paper I and II** **Paper III and IV**	**2** **2**
Non-CGPA	**6**	**AECC-1** **AECC-2**	**English for communication** **English for communication**	
Non - CGPA	**7**	**SEC**	**Skill Enhancement courses**	

B. Sc.Part I Semester I

Paper I: DSC 35A :Fundamentals of Astronomy

Theory :30 hrs Marks : 50 Credit: 02

Unit 1 **30 Lectures**

History of Astronomy and Apparent Luminosity of Stars:

Ptolemy's astronomical work, Copernican heliocentrism and Tychonian system, Luminosity (Apparent and Absolute) of stars, Magnitude scale, Luminosity measurement: 1)Visual Method 2) Photographic method and 3) Photoelectric method. **(7)**

Activity : Prepare a report on historical development of Astronomy(writing and reading skills improvement)

Unit 2:-

Stellar Evolution (HR diagram): Life cycle; Stellar Processes (Nuclear) and spectral classification of Stars O, B, A, F, G, K, M. **(7)**

Activity : Draw the HR diagram using drawing tool app (Enhancing creativity using modern apps)

Unit 3: -

The Sun and Planets

Origin of the solar system, Internal structure and surface features of sun, Sun spots and Magnetic field on the sun and Solar activity.

Surface features of planets, Atmospheres and Magnetic fields of Planets and their moons. **(8)**

Group Activity : Prepare a solar system model and display it in exhibition (hands on minds on and improving presentation skills)

Unit 4

Asteroids, Meteors, Comets and Galaxies:

Asteroids: Discovery and designation, Origin, Nature and Orbits of Asteroids. Meteors : Meteor showers and sporadic meteors.

Comets : Periodic comets, Brightness variation in Comets. Gas production rates, dust and ion tails. (8)

Activity : Check the astronomical calendar and record the event with optical devices (Skill enhancement activity)

List of Reference Books:

1. Astronomy structure of the Universe. A.E. Roy and D. Clarke, Adam Hilger Pub.
2. Source Book of Space Sciences, Samuel Galsstone; D.VanNostrand Co. Inc
3. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, NarosaPub.
4. Structure of the Universe, J.V. Narlikar
5. Introduction to Astrophysics - Baidyanath Basu
6. Astrophysics: Stars and Galaxies- K.D.Abhyankar: Tata McGraw Hill Publication(Chap.2)
7. "Astrophysics: A modern Perspective" - K. S. Krishnaswami New Age International.
8. K. S. Krishnaswami, "Understanding cosmic Panorama" New Age International.

9. Frontiers in Astronomy by Jastrow

B. Sc.Part I Semester I

Paper II: DSC36A:Mathematical course for Astrophysics and Space science

Theory :30 hrs Marks : 50 Credit: 02

Unit1 **30 Lectures**

Vector Algebra and Calculus: **(8)**

Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields, Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities.

(Problem Solving)

Unit II: **(8)**

Curvilinear co-ordinate system: Introduction to Cartesian, Spherical polar and cylindrical coordinate systems, transformation equations. General curvilinear coordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.

(Problem Solving)

Unit III : **(7)**

Matrices

Systems of linear equations, matrix algebra, eigenvalues and eigenvectors, orthogonality and least squares, symmetric matrices and quadratic forms.

(Problem Solving)

Unit IV: **(7)**

Differential equations

Types of differential equations, degree, order, linearity, homogeneity of differential equations, Method of separation of variables for solving partial differential equations, solutions of Laplace equation in two dimension especially wave equation.

(Problem Solving)

References:

1. Mathematical Physics – P. K. Chattopadhyay New Age International Publishers.
2. Mathematical methods in the Physical Sciences (Second Edition) – Marry L. Boas John Willy and Sons Publication.
3. Mathematical methods for Physicists: Weber and Arfken. (6th edition) Academic press – N. Y.
4. Theory and problems of vector analysis- Schaum outline series- Murray R. Spiegel
5. Differential equations - M. L. Khanna, Meerut Publications.
6. Mathematical Physics -H. K. Dass S. Chand and Company Ltd.
7. Mathematical Physics -B. S. Rajput : Pragati Prakashan Ltd.

B. Sc. I Semester II

Paper III: 35B :Introduction to Space Science

Theory :30 hrs Marks : 50 Credit: 02

Unit I. Introduction to Planetary and Interplanetary Space: 30 Lectures

Solar System, Kepler's Laws, Earth-Moon System, Solar and Lunar types, Exploration of Solar System by Telescopes, Rockets and Satellites. **(8)**

Unit II

Structure of Earth's Atmosphere- Lower, Middle and Upper Troposphere (0-10 km), Stratosphere (10-50km), Ionosphere (50-1000 km), Protonosphere (10,000 to 60,000 km towards sun), Interplanetary space (Beyond 60,000 km towards the sun), Earth as a Magnetic Comet. **(8)**

Unit III

Observational and Experimental tools for Astronomy and Space Science:

In-situ measurements of chemical, physical and dynamical parameters using Kites, Balloons, Aeroplanes, Rockets and Satellite Payloads. (7)

Unit IV

Fundamental Particles and basic forces:

Protons, Electrons, Neutrons, Neutrinos, Mesons, leptons, and quarks. The concept of Basic forces viz., strong, weak, electromagnetic and gravitational forces. **(7)**

Activity common to all units : Project on analysis of climate changes causes and remedies (sen

References:

1. Ionospheric Radio Propagation by Kenneth Davis. National Bureau of Standards Monograph 80 (1965), US Government Printing office, Washington D.C.
2. Physics of the Upper Atmosphere edited by J, A. Ratcliffe, Cavendish Laboratory, University of Cambridge. Academic Press New York and London (1960)
3. Research in Geophysics:Vol.1- Sun, Upper Atmosphere and space edited by Hugh Odishaw, National Academy of Sciences. Washington D.C.
4. Source book on the Space Sciences - Samuel Glasstone, Princeton, New Jersey.
5. The Upper Atmosphere - S K Mitra

B. Sc. I Semester II

Paper IV : 36B:Experimental Techniques in Astronomy

Theory :30 hrs Marks : 50 Credit: 02

Unit 1 **30 Lectures**

Electromagnetic spectrum and Astronomer's tools

The nature of light: Light as an electric vibration, the electromagnetic radiation from a heated object, Doppler shift. **(3)**

Tools of the astronomer: Optical telescopes, (Galielian, Newtonian, Cassegranian & Hubble Space Telescope), Magnifying power & Resolving power of telescopes, UV, x-ray, IR, Radio & gravitational Astronomy, Spectroscope. **(5)**

Activity : Measure the RP of Astronomical telescope.

Unit II

Simple methods of Measurements and Astronomical Units: (3)

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

Interferometry: (5)

Michelson's interferometer and it's applications to measure i) wave length of' light ii) refractive index of thin film, construction and working of Fabry – Perot interferometer, superiority of F-P interferometer over Michelson's interferometer.

Activity: Measure the thickness of a thin film by creating an wedge shaped air gap of different steps,

Unit III Detectors (Working Principle only) (8)

spectroscopy, Techniques of observations of astronomical sources from space in infrared. EUV, X-ray and gamma-ray regions of the electromagnetic spectrum.

Activity : Visit an optician laboratory and understanding the working of the lenses

UNIT-IV: Optical Perspective in minimizing errors.

Aberrations: (4)

Aberration in images, Spherical aberration, methods to minimize it, Chromatic aberration, achromatic combination of two thin lenses separated by finite distance.

Eyepieces: (2)

Entrance and exit pupils, Common types of eyepieces, Huygen's eyepiece and Ramsden's eyepiece.

Activity measuring the focal lengths of different lenses available in the laboratory.

REFERENCES

1. Astrophysical Techniques - C. R. Kitchin:

2. Astronomical Observations - an Optical Perspective - Gordon Walker: (Cambridge University press).

3. Astronomical Photometry- Henden and Kaitchuck:

4. Astrophysics-Stars and galaxies - K.D.Abhyankar.
5. Tools of the Astronomers - C. R. Miczaika and W. M. Sinton:
6. Astronomical Techniques- W. A. Hiltner (Ed):
7. Methods of Experimental Physics - Carleton: Vol. XIIA.
8. Geometrical and Physical optics - D. S. Mathur.
9. A Text book of optics (New edition) - Subrahmanyam and Brijlal.
10. Fundamentals of optics - Jenkins and White.
11. Optics (second edition) - Ajay Ghatak.

B. Sc.Part I Semester I Practicals

DSC A(LAB- I)(Paper I &II)

1. I-V Characteristics of solar cell and verification of inverse square law of intensity.
2. Study of Plane diffraction Grating.
3. Determination of focal length of convex and plano-convex lenses by auto collimation method.
4. Calibration of spectrometer.
5. Measurement and identification of spectral lines (Hg and Na source)
6. Intensity distribution curve of ordinary electric bulb using photo cell.
7. Study of solar spectrum
8. Sunspots activity analysis.
9. Measurement of Planck's constant using LED.
10. Measurement of wavelength of given LASER source using diffraction grating.

DSC-B(LAB- II)(PaperIII and IV)

1. Assignment on Vector analysis
2. Problem solving assignment on Differential equations
3. Problem solving assignment on Matrices
4. Constellation map drawings – a) Orion b) Ursa Major (Big Dipper) c) Auriga d) Taurus.
5. To use idea of parallax to determine large distance.
6. Spherical aberration (caustic curve).
7. Resolving power of telescope.
8. Resolving power of Microscope.
9. Cardinal Points by Newton's method
10. Study of polar graph.

- **Report on Field Visit to any local space centre or laboratory or Observatory will remain mandatory.**

Scheme of Marking (Theory)

Sem	Core Course	Marks	Evaluation	Papers	Answer Books	Standard of Passing
I	DSC-A 35A & 36A	100	Semester Wise	Two papers of 50 marks	As per instructions	35%
II	DSC-A 35B & 36B	100	Semester Wise	Two papers of 50 marks	As per instructions	35%

Nature of Question Paper Theory: Time -2 hours, Marks-50 Credits-2
Question 1: Select the correct alternative (Compulsory 10 questions) 10 marks (Four alternatives for each question)
Question 2: (Attempt any Two out of three) 20 marks (Long answer type)
Question 3: (Attempt any four out of six) 20 marks (Short answer type)
Note: Equal weightage should be given to each unit.

Scheme of Marking (Practical)

Sem	Course	Marks	Evaluation	Sections	Standard of Passing
I AND II	DSC-A LAB & DSC-B LAB	50	Annual	As per instructions	35%

- Scheme of Practical Examination for B. Sc. Part –I

1. Practical examination will be conducted annually.
2. Practical examination will be conducted for one day per batch.
3. The examination will be conducted in two sessions per day and each session will be of three hours duration.
4. Every candidate should perform one experiment each from Lab A and Lab B .
5. At least eighty percent practical should be completed by the student.
6. The marks distribution for practical is as below

Practical groups	**Marks**
Group I	20
Group II	20
Certified Laboratory Journal and sky observation report or report on field visit to space lab	10
Total marks	50

Learning Outcomes :

Semester	**Paper No**	**Paper Code**	**Unit**	**Outcome**
I	I	DSC 35A	1	They will learn the historical development of the subject
			2	They will understand the life cycle of a star
			3	Understanding of our own solar system
			4	Observing and analyzing celestial events
I	II	DSC 35 B	1	Applying vector laws in analyzing natural phenomena
			2	Understanding for curvilinear coordinates for locating the positions of celestial objects
			3	Matrix formulation for dynamic variables
			4	Setting and solving differential equations for physical phenomena.
II	III	DSC 36A	1	Familiarization with planetary system
			2	Understanding the earth's atmospheres and significance of different layers in it.
			3	Understanding the different tools for observational astronomy.
			4	Realizing the basic forces of nature
II	IV	DSC 36B	1	Knowing different window for exploring universe
			2	Working principles, methods and units used for measuring celestial parameters
			3	Working principles of different modern detectors used for space exploration
			4	Understanding working principles of optical instrument and analyzing the errors of the instruments.