Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AN AUTONOMOUS COLLEGE)

Reaccredited by NAAC with 'A+' Grade

Bachelor of Science

Part - II

PHYSICS

Syllabus

to be implemented w .e. f. June, 2022

Structure of the course:

2) Semester III

Sr. No.	Subject title	Theory					Practical	
		Course No. and Course code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Physics	Course V BPT301	Heat and Thermal Physics	3	2	Heat, Thermal Physics, Waves, Oscillations and Sound BPP303	8	4
		Course VI BPT302	Waves, Oscillations and Sound	3	2			

2) Semester IV

Sr. No	Subject title	Theory					Practical	
		Course No. and Course Code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Physics	Course VII BPT401	Modern Physics and Electronics	3	2	Practical IV BPP403	8	4
		Course VIII BPT402	Optics and Lasers	3	2			

B.Sc. II : Evaluation structure

Semester III.

	ESE	Internal Exam		Practical			Submission	Total
		ISE-I	ISE-II		Exam	Journal	Seminar + Student Performance	
Course V	30	5	5	Practical-III(A)	25	5	5	150
Course VI	30	5	5	Practical IV(A)	25	5	5	

Semester IV

	ESE	Internal Exam		Practical			Submission	Total
		ISE-I	ISE-II		Exam	Journal	Industrial visit/Educational Tour + Student Performance	
Course V	30	5	5	Practical-III(A)	25	5	5	150
Course VI	30	5	5	Practical IV(A)	25	5	5	

Structure and titles of the course of B.Sc. II course

Semester III

Code	Name of Course	Units
BPT301	**Heat and Thermal Physics** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Ideal, Real gas and Thermometry **Unit II:** Kinetic Theory of gases and Transport Phenomena **Unit III :** Thermodynamics **Unit IV :** Thermodynamic Potential
BPT302	**Waves, Oscillations and Sound** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Oscillations **Unit II**: Wave motion **Unit III :** Sound **Unit IV :** Ultrasonic Waves

Semester IV

BPT401	**Modern Physics and Electronics** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Special theory of Relativity **Unit II**: Matter Waves **Unit III :** Transistor **Unit IV :** Oscillator
BPT402	**Optics and Lasers** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Geometrical optics **Unit II:** Interference of light **Unit III** : Polarization of light **Unit IV :** Laser system

Semester – III

Course – **V** BPT301 **Heat and Thermal Physics**

Course Objectives: Student will able to

1. Understand kinetic interpretation of temperature, Andrew's Expt. and different types of thermometers.
2. Study kinetic theory of gases and concept of Transport phenomena.
3. Understand thermo-dynamical state, thermodynamic equilibrium, various thermodynamic processes and first law of thermodynamics.
4. Study Thermodynamic Potential, Maxwell's Relations and applications.

Credits (Total Credits 2)	**SEMESTER-III** **BPT301** **Heat and Thermal Physics**	**No. of hours per unit/credits**
UNIT - I	**Ideal, Real gas and Thermometry**	**(11)**
	Kinetic Interpretation of temperature, Andrew's experiment and curve, critical constants, Relation between critical constants and Van der waal's constants, Reduced equation of state. Principle of thermometry, types of thermometers, Scales of temperature (Celsius, Kelvin, Fahrenheit and Rankine), Mercury thermometer, Thermoelectric thermometer, Platinum resistance thermometer, Thermister.	
UNIT - II	**Kinetic Theory of gases and Transport Phenomena**	**(11)**
	Review, Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path, Transport phenomena-Transport of momentum(viscosity), Transport of thermal energy (conduction), Transport of mass (diffusion), Degrees of freedom, Law of equipartition of energy (No derivation) and its application to specific heat of gases (mono and diatomic).	
UNIT - III	**Thermodynamics**	**(12)**
	Second law of thermodynamics (Explanation and different statements), Carnot's ideal heat engine, Carnot cycle (working and efficiency), Carnot's theorem, Entropy (concept and significance), Entropy changes in reversible and irreversible processes, Entropy –Temperature diagram, Third law of thermodynamics, Heat Engines in practice, Rankine cycle, Steam Engine, Internal Combustion Engine a) Otto Engine b) Diesel Engine.	

UNIT - IV	Thermodynamic Potential	(12)
	Enthalpy, Gibbs function, Helmholtz and Internal Energy function, Maxwell's Relations and applications, Joule – Thompson effect, Clausius- Clapeyron Equation, Expressions for (Cp- Cv) and Cp/ Cv , TDS equation.	

Course Outcomes: Students should be able to

1. explain the concept of mean free path, Transport of momentum, thermal energy and mass
2. understand Andrew's expt., Curve and different types of thermometers
3. differentiate otto engine and diesel engine and apply the concept of entropy
4. analyze Enthalpy and TDS equation

References-

1. Brijlal and N. Subramanyam, 2001, Heat and Thermodynamics, S.Chand and Company Ltd. Publisher.
2. D. S. Mathur, 2008, Heat and Thermodynamics, S. Chand and Sons Ltd. Publisher.
3. J. B. Rajam and C. L. Arora, 2009, Text book of Heat and Thermodynamics, S. Chand and Company Ltd Publisher
4. Meghnad Saha and B.N. Srivastava, 1935, A treatise on Heat, Indian Press Ltd., 2nd edition.
5. M.W. Zemansky and R. Dittman, 2011, Heat and Thermodynamics,Tata McGraw-Hill Education Pvt. Ltd., 8th
6. J. P. Agrawal and Satya Prakash,2018, Heat Thermodynamics and Statistical Physics, Pragati Prakashan.

Course – **VI** BPT302 **Waves, Oscillations and Sound**

Course Objectives: Students will be able to

1. understand SHM and its solution, superposition principle and Lissajous figures and their uses.

2. study travelling and standing waves on a string, plane waves and spherical waves.
3. study transducers and their types, to understand concept of acoustics of buildings, Sabine's experimental work and reverberation time.
4. understand the Piezo-electric effect, detection of Ultrasonic waves and applications of Ultrasonic waves.

Credits (Total Credits 2)	SEMESTER-III BPT302 Waves, Oscillations and Sound	No. of hours per unit/credits
UNIT - I	**Oscillations**	**(11)**
	Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and potential energy, Kater's pendulum, Damped oscillations, Superposition of two collinear harmonic Oscillations: Linearity and superposition principle 1) Oscillations having equal frequencies along the line and 2) Oscillations having different frequencies along the same straight line (beats), Lissajous figures with equal and unequal frequencies and their uses.	
UNIT - II	**Wave motion**	**(11)**
	Transverse waves on a string, travelling and standing waves on a string, normal modes of a string, Laws of vibration, Energy density and energy transport of transverse wave along a stretched string group velocity, phase velocity, plane waves and relation between them, spherical waves, intensity of a wave	
UNIT - III	**Sound**	**(11)**
	Acoustics Transducers (Qualitative), pressure microphone, moving coil loud speaker, Digital audio system. **Acoustics of Buildings:** Reverberation time, factors affecting acoustics of buildings, Sabine's experimental work and formula, optimum reverberation time, Requirements of good acoustics.	
UNIT - IV	**Ultrasonic Waves**	**(12)**

	Piezo-electric effect, Magnetostriction effect, production of ultrasonic waves- magnetostriction oscillator, Piezo-electric oscillator, detection of ultrasonic waves- Kundt's tube, sensitive flame method, thermal detector, quartz crystal method, Magnetostrictive method, applications of ultrasonic waves- medical field, SONAR, chemical field, cracks in metals, formation of alloy, sterilization, enemy of lower life.	

Course Outcomes: Students should be able to

1. explain superposition principle, Lissajous figures and their uses
2. understand plane waves, spherical waves
3. differentiate concept of acoustics of buildings, Sabine's experiment and reverberation time.
4. analyze detection of ultrasonic waves and their applications.

References

1. Halliday and Resnick, 2011, *Fundamentals of Physics Volume 1,* 9th edition, Wiley Publisher.
2. Subrahmanyam and Brijlal, 2018, *A text book of Sound*, 2nd edition, S. Chand Publisher.
3. D. S. Mathur, 2010, *Elements of properties of matter*, S. Chand and Co Ltd. Publisher.
4. D. R. Khanna and R. S. Bedi,1971, *Textbook of Sound*, Atma Ram and Sons Publisher.
5. D. Chattopadhyay, 2016, *A Treatise on oscillations, waves and acoustics*, Books and allied Pvt. Ltd. Publisher.
6. J. Walker, David Halliday and Robert Resnick, 2014, *Principles of Physics*,10th edition, Wiley Publisher.
7. Satya Prakash, 2017, *Oscillations and Waves*, Pragati Prakashan.

BPP 303 Thermal Physics, Waves, Sound, Optics

Course Objectives: Student will be able to

1. learn measuring skills in practical.
2. understand period of oscillations, frequency of a wave and acceleration due to gravity.
3. understand the length of vibrating air columns, Resonance and can measure velocity of sound.
4. learn thermal conductivity, temperature coefficient of resistance and specific heat.

Credits (Total Credit 04)	SEMESTER-III BPP 303 Thermal Physics, Waves, Sound, Optics	No. of hours per unit/credits
	Group - A	
	1. To determine Coefficient of Thermal Conductivity of a bad conductor by Lees method. 2. To determine Coefficient of Thermal Conductivity of copper by Searle's apparatus. 3. To study the variation of thermo-emf with temperature across two junctions of a thermocouple 4. To determine temperature coefficient of resistance of a given coil by P. O. box. 5. To determine the thermal conductivity of a metal rod by Forbe's method. 6. To determine Coefficient of Thermal Conductivity of glass in the form of a tube. 7. To determine the specific heat of a liquid (turpentine oil) by law of cooling. 8. To determine the ratio of specific heat of air by Clement and Desorme's method. 9. To investigate the motion of coupled oscillations. 10.To determine acceleration due to gravity by using Bifilar Pendulum.	
	Group - B	
	1. Determination of dispersive power of material of prism. 2. Study of cardinal points using Goniometer. 3. Determination of Cauchy's Constants. 4.. Determination of specific rotation of sugar solution using Polarimeter. 5. To study Lissajous figures. 6. Measurement of velocity of sound by Kundt's tube method.	

	7. Measurement of Velocity of Sound by CRO. 8. Measurement of Velocity of Sound by Resonating Bottle. 9. Measurement of log decrement by Exponential Decay. 10.To determine the frequency of Crystal oscillator.	

Course Outcomes: Students should be able to

1. learn measuring skills in practical
2. determine thermal conductivity and temperature coefficient of resistance
3. understand thermo-emf and specific heat
4. explain period of oscillations
5. measure frequency of a wave
6. understand the concept of acceleration due to gravity
7. measure the length of vibrating air columns and velocity of sound.

Practical references-

1. B.L. Worsnop ,H.T. Flint,1951, *Advanced Practical Physics for Students* , 9th ed., Littlehampton Book Services Ltd.
2. S. L. Gupta and V. Kumar, 2010,*Practical Physics, 27th ed, Pragati Prakashan*
3. *D. Chattopadhyay* ,P. C. Rakshit,2005,An Advanced course in Practical Physics, New Central Book Agency Pvt. Ltd. ition.
4. Marsh W. White , Kenneth V. Manning ,1954, *Experimental College Physics* , 3rd ed, McGraw Hill Higher Education.
5. H. Singh and P. S. Hemne, 2011, *B.Sc. Practical Physics*, 4th ed , S. Chand Publication.
6. C. L Arora, 1957, *B.Sc. Practical Physics,* S. Chand Publication

SEMESTER- IV

Course **VII** BPT401 **Modern Physics and Electronics**

Course Objectives: Students will be able to

1. understand special theory of relativity
2. study wave particle duality
3. study various characteristics of transistor
4. study various types of oscillator

Credits (Total Credits 2)	SEMESTER-IV BPT401 Modern Physics and Electronics	No. of hours per unit/credits
UNIT - I	**Special theory of Relativity**	**(11)**
	Inertial and Non-Inertial frame of references, Galilean transformation equations, Michelson- Morley experiment, Ether hypothesis, Postulates of special theory of relativity, Lorentz transformation equations, Relativistic addition of velocities, Length contraction, Time dilation, variation of mass with velocity, mass energy relation.	
UNIT - II	**Matter Waves**	**(11)**
	Wave particle duality, De-Broglie hypothesis of matter waves, Derivation of wavelength of matter wave, Concept of wave packet, Relations between group velocity - phase velocity and group velocity-particle velocity, Davisson and Germer experiment, Uncertainty principle (statement only): position–momentum and energy- time, Application of uncertainty principle non existence of free electrons in the nucleus.	
UNIT - III	**Transistor**	**(11)**
	Revision of Bipolar Junction Transistor (BJT), Single stage common emitter transistor amplifier, Frequency response curve of an amplifier, negative and positive feedback, Effect of negative feedback on the gain response curve, Problems.	
UNIT - IV	**Oscillator**	**(12)**

	Introduction, Types of waves, Oscillations from tank circuit, Barkhausen's criterion for sustained oscillations, Phase shift oscillator, Colpitt's oscillator, Problems.	

Course Outcomes: Students should be able to

1. explain postulates of special theory of relativity
2. understand concept of wave packet and Uncertainty principle
3. differentiate negative and positive feedbacks in transistor
4. analyze oscillators and oscillations

References

1. Albert Einstein, Relativity: The Special and the General Theory (Fingerprint Publishing, 2017) 2-62.
2. Robert Resnick, Introduction to Special Relativity (Wiley; 1st edition, 2007) 1-188.
3. Nouredine Zettili, Quantum Mechanics Concept and Applications (A John Wiley and Sons Ltd Publisher, 2nd edition, 2009) 10-222.
4. G. Aruldas, Quantum Mechanics (Prentice Hall India Learning Private Limited Publisher, 2nd edition, 2008) 4-48.
5. V.K. Mehta, Rohit Mehta, Principles of Electronics (S Chand; 10th Rev. Edn. 2006 edition, 2005) 33-541.

Course – **VIII BPT402 Optics and Lasers**

Course Objectives: student will be able to

1. understand the concept of cardinal points, working of Searle's goniometer, optical magnifications, difference between resolving and magnifying powers.
2. study division of amplitude, division of wavefront, formation of interference in various films, Fresnel diffraction, Fraunhofer diffraction and a convex lens.
3. understand structure and types of optical fibers, principle and working of fiber optic communication system, working of some lasers and idea of Holography.
4. understand polarization principle, construction and working of polarimeter.

Credits (Total Credits 2)	SEMESTER-IV BPT402 Optics and Lasers	No. of hours per unit/credits
UNIT - I	**Geometrical optics**	**(12)**
	Definition and properties of cardinal points of a lens system, coincidence of principal points and nodal points, Image formation by cardinal points, Newton's formula, relation between focal lengths of an optical system, axial, lateral and angular magnifications; Abbe's sine condition. **Resolving power** Resolving power, Rayleigh's criterion for the limit of resolution, comparison between magnifying power and resolving power, resolving power of plane diffraction grating, resolving power of prism.	
UNIT - II	**Interference of light**	**(11)**
	Principle of superposition of waves, Division of amplitude, division of wavefront, interference in thin parallel films due to reflected light, wedge shaped films, Newton's rings, its applications for determination of wavelength of light and R.I. of liquid. **Diffraction of light:** Types of diffraction, Fraunhofer diffraction: plane diffraction grating, theory of plane diffraction grating, its application to determine wavelength of monochromatic light, Fresnel diffraction: half period zones, zone plate, Fresnel diffraction at Narrow wire.	
UNIT - III	**Polarization of light**	**(11)**
	Polarization by double refraction, Huygens explanation of double refraction through uniaxial crystals, optical rotation laws of rotation of plane of polarization, polarimeter.	
UNIT - IV	**Laser system**	**(11)**
	Absorption, spontaneous and stimulated emission, Einstein coefficients (only definitions), population inversion, optical and electrical pumping, properties of lasers, Ruby laser, Helium-Neon laser, uses of laser, idea of holography(qualitative treatment only).	

Course Outcomes: Students should be able to

1. explain cardinal points, working of Searle's goniometer and optical magnifications
2. understand Fresnel diffraction, Fraunhofer diffraction, half period zones, zone plates and difference between zone plate and a convex lens.
3. differentiate structure and types of optical fibers, principle and working of fiber optic communication system.
4. analyze principle, construction and working of polarimeter.

References

1. Longhurst, R. S. 1967. *Geometrical and physical optics*. 2nd edition, New York: Wiley.
2. Brij Lal, M. N. Avadhanulu and N. Subrahmanyam. 2012. A *Textbook of Optics*. 25th edition. S. Chand Publisher,
1. Ajoy Ghatak, 2008. *Optics*. 4th edition, McGraw Hill Education India Pvt Ltd.
2. Laud, B. B. 2011. *Lasers and non-linear optics*. New Delhi: New Age International Publishers.
3. J. P. Agarwal, 2017. *Physical optics and lasers,* 13th edition, Pragati Prakashan.
4. Mathur, B. K. 1964. *Principles of optics*. Kanpur: Gopala Printing.
5. Thyagarajan, K., and Ajoy Ghatak. 2011. *Lasers Fundamentals and Applications*, 2nd edition, Springer Science and Business Media Publisher.
6. R. Murugeshan and K. Sivaprasath, 1997. *Optics and Spectroscopy,* 10th edition, S. Chand Publisher.

BPP 403 Thermal Physics, Optics and Lasers

Course Objectives: Students will be able to

1. develop practical skills.
2. determine mechanical equivalent of heat, specific heat of solids and liquids.
3. study the laws of probability distribution, black body radiation.
4. study the cardinal points of an optical system.

Credits (Total Credit 04)	SEMESTER-IV BPP 403 Thermal Physics, Optics and Lasers	No. of hours per unit/credits
	Group - A	
	1. To determine Mechanical Equivalent of Heat J by Callendar and Barne's constant flow method. 2. To determine specific heat capacity of liquid by Callendar and Barne's constant flow method. 3. To determine Stefan's Constant. 4. Measurement of Planck's constant using black body radiation. 5. To verify the laws of Probability Distribution and to verify laws of probability of throwing one coin, two coins and then coins (or more). 6. The study of Statistical Distribution from the given data and to find most probable, average and rms values. 7. Specific Heat Capacity of Graphite and its variation with temperature. 8. Study of temperature coefficient of Thermistor. 9. To determine the ratio of specific heats of air by Kundt's tube. 10. Thermal conductivity of rubber tubing.	
	Group - B	
	1. To investigate the motion of coupled oscillations. 2. To determine acceleration due to gravity by using Bifilar Pendulum 3. Measurement of Velocity of Sound by Sonometer. 4. Determination of equivalent focal length of a system of lenses by using Goniometer. 5. Determination of R.I. of given liquid by Liquid Lens. 6. Determination of Resolving Power of plane diffraction grating. 7. Determination of wavelength of Sodium Light by Fresnel's Bi-prism. 8. Determination of Wavelength of sodium source by Newton's rings. 9. Determination of Wavelength of He-Ne Laser using grating. 10. Study of cardinal points by Newton's Method.	

Course Outcomes: Students should be able to

1. take measurements and readings with practical skills.
2. determine mechanical equivalent of heat, specific heat of solids and liquids.
3. study the laws of probability distribution, black body radiation.

4. determine dispersive power, refractive index, resolving power of various materials, wavelengths of different sources by various methods.
5. plot the cardinal points of an optical system.

REFERENCE BOOKS:

1. B. L. Worsnop and H. T. Flint, 9th edition 1961 Advanced Practical Physics for Students, Asia Pub. House.
2. S. L. Gupta and V. Kumar, 27th edition, 2010 Practical Physics, Pragati Prakashan.
3. D. Chattopadhyay and P. C. Rakshit, 7th edition, 2005 An Advanced Course in Practical Physics, New Central Book Agency Pvt. Ltd., .
4. White and Manning, 3rd edition 1954, Experimental College Physics, McGraw-Hill Book Company,.
5. H. Singh and P.S. Hemne, 4th edition, 2011 B.Sc. Practical Physics.S. Chand Publisher,
6. C. L. Arora,1957, B.Sc. Practical Physics, S. Chand Publisher, .

Structure of the course:

2) Semester III

Sr. No.	Subject title	Theory					Practical	
		Course No. and Course code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Physics	Course V BPAT 301	Fundamentals of Astronomy	3	2	**Numerical Calculations, Parallax, Photometry And Sound** BPAP 303	8	4
		Course VI BPAT 302	Fundamentals of Astrophysics	3	2			

2) Semester IV

Sr. No	Subject title	Theory					Practical	
		Course No. and Course Code	Title of Course	No. of lectures per week	Credits		No. of lectures per week	Credits
1.	Physics	Course VII BPAT 401	Galaxies, Planets and Cosmology	3	2	**Spectroscopy, Magnetism And Electronics** BPAP403	8	4
		Course VIII BPAT 402	Hydrodynamics and Cosmic Electrodynamics	3	2			

B.Sc. II : Evaluation structure

Semester III.

	ESE	Internal Exam		Practical			Submission	Total
		ISE-I	ISE-II		Exam	Journal	Seminar + Student Performance	
Course V	30	5	5	Practical-III(A)	25	5	5	150
Course VI	30	5	5	Practical IV(A)	25	5	5	

Semester IV

	ESE	Internal Exam		Practical			Submission	Total
		ISE-I	ISE-II		Exam	Journal	Industrial visit/Educational Tour + Student Performance	
Course V	30	5	5	Practical-III(A)	25	5	5	150
Course VI	30	5	5	Practical IV(A)	25	5	5	

Structure and titles of the course of B.Sc. II course

Semester III

Code	Name of Course	Units
BPT301	**Fundamentals of Astronomy** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** History and Luminosity of Stars **Unit II:** The Sky and the Calendar **Unit III :** The Stellar distances **Unit IV :** Comets, Asteroids and Meteors, Masses and Radii of Stars
BPT302	**Fundamentals of Astrophysics** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Electromagnetic Radiation and Message of the star light **Unit II**: Tools of the Astronomer **Unit III :** The Hertzsprung-Russell diagram and Nuclear Energy source **Unit IV :** Stellar Evolution

Semester IV

BPT401	**Galaxies, Planets And Cosmology** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Galaxies **Unit II**: The Milky Way Galaxy and Solar System **Unit III :** Planets **Unit IV :** Cosmology
BPT402	**Hydrodynamics And Cosmic Electrodynamics** (CREDITS:02; TOTAL HOURS : 45)	**Unit I:** Fluid Statics **Unit II:** Fluid Dynamics **Unit III** : Electrodynamics and Scattering of Radiations **Unit IV :** The Sun and Solar

		Activity

Semester – III

Course – **V** BPT301 **Fundamentals of Astronomy**

Course Objectives: Student will be able to

1. learn history of Astronomy, apparent luminosity and its measurement and absolute luminosity.
2. learn calendar of sky, celestial sphere, celestial co-ordinates, universal equatorial system and objects in the sky.
3. study measurement of terrestrial distances and various methods for their measurement.
4. study comets, asteroids, meteors, measurement of mass and radii of stars.

Credits (Total Credits 2)	**SEMESTER-III** **BPAT301** **FUNDAMENTALS OF ASTRONOMY**	**No. of hours per unit/credits**
UNIT - I	**History and Luminosity of Stars**	**(11)**
	Ptolemy's astronomical work, Copernican heliocentric system, Tycho and Kepler's system, Galileo work, Newton's law of gravitation, Kepler's laws of planetary motion, Luminosity (apparent and absolute) of stars, Magnitude scale, Measurement of apparent luminosity by i) visual method ii) photographic method iii) photoelectric method.	
UNIT - II	**The Sky and the Calendar**	**(11)**
	Motion of the Earth, Sidereal day and sidereal time, Celestial co-ordinates, Celestial sphere, Universal equatorial system, Calendars, The Moon , Sun and stars as calendars , The constellations – Aries , Pisces, Orion and Cassiopeia, Interesting objects in the sky (Summer triangle, North Polaris and Big dipper (Saptarishi), Dark cloud constellations.	

UNIT - III	**The Stellar distances**	**(12)**
	Measurement of terrestrial distances, Measurement of distances within solar system (Moon, planet and Sun), Astronomical unit and its measurement by aberration of star light, Trigonometric parallaxes of stars, The method of luminosity distance (concept of absolute magnitude), Spectroscopic parallax, Period luminosity law, Use of other bright objects.	
UNIT - IV	**Comets, Asteroids and Meteors, Masses and Radii of Stars**	**(12)**
	Comets, Asteroids and meteors (structure, chemical composition and orbits), Kepler's third law for estimation of solar mass, Measurement of stellar radii (direct and indirect method).	

Course Outcomes: Students should be able to

1. explain earlier astronomical work.
2. understand celestial sphere, celestial co-ordinates and universal equatorial system
3. differentiate methods of luminosity measurement.
4. analyze stellar radii by various methods

References-

1. R. Jastrow, M. H. Thomson John Wiley, 1984, Astronomy Fundamentals and Frontiers,Sons Publications, (4^{th} revised edition).
2. Thomas T. Arny Mosley, 1994, Exploration – An Introduction Astronomy, - Year Book Inc (3rd edition).
3. Jay M. Pasachoff 1992 Books /Cole Thomson Course, Astronomy – From the Earth to the Universe. W B Saunders Co Ltd; (4^{th} revised edition)
4. Baidhnath Basu, 2014 An Introduction to Astrophysics by PHI Course Pvt. Ltd. New Delhi. (2^{nd} edition).
5. Theo Koupelis Jones 2010, and Barttlett Course, In Quest of the Universe, LLC Publications. (6^{th} dition).
6. Jones and Bartlett ,2010, Exploring Space (The high Frontier) Jones & Bartlett Course; Har/Cdr (6^{th} edition).

7. K. D. Abhyankar,1992, Astrophysics – Stars and Galaxies by Tata McGraw Hill Publishing Company (1th edition).
8. Michael Zeilik and Stephen A. Gregar,1997, Introductory Astronomy and Astrophysics by Saunders College Publishing, (4th edition).
9. Martin Harwit A 2006 , Astrophysical Concepts by A Library, Springer, USA. (4th edition).

Course – VI BPT302 Fundamentals Of Astrophysics

Course Objectives: Students will be able to

1. study electromagnetic radiation from stars, atomic spectra and classification of stars.
2. study various tools of astronomer.
3. learn Hertzsprung - Russel diagram for population of stars and nuclear energy source of stars.
4. learn stellar evolution of small and massive star, pulsars, neutron star and black holes.

Credits (Total Credits 2)	SEMESTER-III BPT302 Fundamentals of Astrophysics	No. of hours per unit/credits
UNIT - I	**Electromagnetic Radiation and Message of the star light**	**(11)**
	Electromagnetic radiation, Electromagnetic radiation from heated object, Doppler shift, Atomic spectra, Emission spectra, Absorption spectra, Stellar spectra, Classification of stellar spectra. (Classification of star).	
UNIT - II	**Tools of the Astronomer**	**(11)**
	Optical telescope (Galilean, Newtonian, Cassegranian and Hubble space telescope), Magnifying power of telescope, Resolving power of telescope, Spectroscope (Prism and grating), Radio telescope, X - ray Astronomy, UV Astronomy, IR Astronomy.	
UNIT - III	**The Hertzsprung-Russell diagram and Nuclear Energy source**	**(11)**

	The colour of glowing object (stars), Brightness (luminosity) of stars, HR diagram (population of stars, main sequence, dwarfs and giants), Nuclear fission, Nuclear fusion, Nuclear reaction in stars.	
UNIT - IV	**Stellar Evolution**	**(12)**
	Protostar, birth, maturity, Aging of stars (main sequence), Death of small stars, Death of massive stars (supernova explosion), Pulsars and neutron stars, Black hole	

Course Outcomes: Students should be able to

1. explain electromagnetic radiation and electromagnetic radiation from heated object.
2. understand optical telescopes (Galilean, Newtonian, Cassegranian and Hubble space telescope).
3. differentiate death of small stars and massive stars, pulsars (neutron stars) and black holes.
4. analyze HR diagram (population of stars, main sequence, dwarfs and giants).

References

1. R. Jastrow, M. H. Thomson, 1984, *Astronomy Fundamentals and Frontiers*, 4th revised edition, New York: John Wiley and Sons Publications.
2. Thomas T. Arny, 1994, *Exploration – An Introduction to Astronomy*, 3rd edition, Mosley-Year Book Inc.
3. Jay M., 1992, *Astronomy – From the Earth to the Universe,* 4th revised edition, Pasachoff Books /Cole Thomson Course. W B Saunders Co Ltd.
2. Theo Koupelis Jones and Barttlett Course, 2010, *In Quest of the Universe,* 6th edition, LLC Publications.
3. K. D. Abhyankar, 1992, *Astrophysics – Stars and Galaxies*, 1st edition, Tata McGraw Hill Publishing Company.
4. Michael Zeilik and Stephen A. Gregary, 1997, *Introductory Astronomy and Astrophysics*, 4th edition, Saunders College Publishing.

5. Baidhnath Basu, 2014, *An Introduction to Astrophysics,* 2nd edition PHI Course Pvt. Ltd. New Delhi.

BPAP 303 Numerical Calculations, Parallax, Photometry And Sound

Course Objectives: Student will be able to

1. learn the numerical calculations.
2. learn the parallax.
3. study magnifying and resolving powers of telescopes.
4. learn the drawing of constellation maps.

Credits (Total Credit 04)	SEMESTER-III BPAP 303 Numerical Calculations, Parallax, Photometry And Sound	No. of hours per unit/credits
	Group - A	
	1. Numerical integration. 2. Numerical differentiation. 3. Numerical Interpolation. 4. Solution of ordinary differential equations. 5. To use the idea of parallax to determine large distances. 6. Measurement of terrestrial distance using Sextant. 7. Lummer Brothum Photometer (comparison of intensities). 8. Spherical Aberration (Caustic Curve). 9. Michelson Interferometer.	
	Group - B	
	1. Resolving power of telescope. 2. Magnifying power of telescope. 3. Goniometer (Equivalent focal length). 4. Goniometer (Cardinal points). 5. Study of scattering of light (Diameter of Lycopodium powder). 6. Velocity of sound using CRO and Microphone. 7. Constellation Map drawings- a) Orion b) Ursa Major(Big Dipper) 8. Constellation Map drawings c) Auriga d) Taurus. 9. Sun spot activity analysis.	

Course Outcomes: Students should be able to

1. solve the numerical problems in astronomy and astrophysics.
2. understand the skill of parallax zeroing techniques.
3. determine the magnifying and resolving powers of refracting telescopes.
4. study the drawing of constellation maps of Orion, Big dipper, Auriga and Taurus.

Practical references-

1. B. L. Worsnop and H. T. Flint,1969, Advanced practical Physics for Students, 9th revised edition,London:Methuen.
2. Harnam Singh and Dr. P. S. Hemne,2014 , B. Sc. Practical Physics, Delhi: S. Chand Publishing.
3. C. L. Arora ,2010, Practical Physics, New Delhi: S. Chand and company limited.
4. Dr. S. P. Singh, 2012 , Advanced Practical Physics Vol. – I, Meerat :Pragati Prakashan.
5. Dr. S. P. Singh, 2012 , Advanced Practical Physics Vol. – II, Meerat :Pragati Prakashan.

SEMESTER- IV

Course **VII** BPT401 **Galaxies, Planets And Cosmology**

Course Objectives: Students will be able to

1. learn galaxies, types of galaxies, evolution of galaxies, their halos, radio galaxies and quasars
2. study our own galaxy the Milky way, stellar population and solar system (condensation theory)
3. study planet. the Earth, Venus, mercury and Earth's natural satellite- the Moon.
4. study structure of universe, different theories of cosmos.

Credits (Total Credits 2)	SEMESTER-IV BPAT 401 Galaxies, Planets And Cosmology	No. of hours per unit/credits
UNIT - I	**Galaxies**	**(11)**
	Types of galaxies, Dwarf galaxies, Colliding galaxies, Galactic cannibalization (CD galaxies), Anomalously luminous galaxies, The massive galactic halo, The evolution of galaxies, Cluster of galaxies, The intergalactic medium, Super clusters and voids. Radio galaxies, Twin lobed shape of radio galaxy. Quasars-Discovery, Red shift, Distances, Luminosities and nature of quasar energy source.	
UNIT - II	**The Milky Way Galaxy and Solar System**	**(11)**
	Properties of Milky way galaxy, The spiral structure of the galaxy, The interstellar medium, Clusters of stars, Globular clusters, Stellar population. General properties of Solar system – Origin of planets (condensation theory), Origin of earthlike planets, Composition of planets.	
UNIT - III	**Planets**	**(11)**
	The Earth – early history, Radioactive heating of the earth, Differentiation of earth's interior, The floating crust, Plate tectonics- the zone of weakness, A map of earth's plates, Evidence for continental drift, Terrestrial planets – Mercury, Venus, Mars- planetary properties, Prospects for life on mars. The Moon – Lunar surface and interior, theories of Moon.	
UNIT - IV	**Oscillator**	**(12)**

	The expanding Universe, The Big-bang cosmology, The Hubble law, The age of the Universe, The steady state cosmology, Evidence for the Big-bang, Conditions in the evolving Universe, The oscillating Universe, Open and closed Universes.	

Course Outcomes: Students should be able to

1. explain galaxy the Milky Way galaxy, intergalactic medium, properties of solar system and the condensation theory.
2. understand plate tectonics, continental drift, the two super continents- Laurasia and Gondwana land, the terrestrial planets, the red planet- Mars.
3. differentiate the structure and evolution of cosmos.
4. analyze the open and closed universe.

References

1. R. Jastrow, M. H. Thomson, 1984, Astronomy Fundamentals and Frontiers, 4th revised edition, New York: John Wiley and Sons Publications.
2. Theo Koupelis Jones and Barttlett Course ,2011, In Quest of the Universe,6th edition, Sudbury, MA : Jones and Bartlett Publishers.
3. Jones and Bartlett, 2010, Exploring Space - The high Frontier , Jones & Bartlett Course;6th edition, Har/Cdr.
4. Jay M. Pasachoff ,2003, Astronomy:From the Earth to the Universe, 6th revised edition, South Melbourne Brooks/Cole Thomson Learning.
5. Thomas Arny; Stephen E Schneider; 2020, Exploration – An Introduction to Astronomy, 9th edition,New York : McGraw-Hill.
6. Martin Harwit,2010, Astrophysical Concepts , 4th edition, New York : Springer.

Course – **VIII BPAT 402 Hydrodynamics And Electrodynamics**

Course Objectives: student will be able to

1. study types of fluid, terms related to the fluid, Pascal's law and application of Pascal's law

2. Study types of fluid flow, Reynold's number, Bernoulli equation, Euler's equation of motion and The Navier-Stoke's equation.
3. study Maxwell's equations, electromagnetic wave equation and scattering of light.
4. understand the interior of Sun, the photosphere, the chromospheres and corona.

Credits (Total Credits 2)	**SEMESTER-IV** **BPAT 402** **Hydrodynamics And Electrodynamics**	**No. of hours per unit/credits**
UNIT - I	**Fluid Statics**	**(12)**
	Definition of fluid, Fluids and their properties, Types of fluid, mass density, specific weight, specific gravity, viscosity, viscosity laws, Surface tension, Capillarity, Pascal's law, Applications of Pascal's law, Condition of Equilibrium of floating and submerged bodies.	
UNIT - II	**Fluid Dynamics**	**(11)**
	Streamline, Flow line, Types of flow: Streamline and Turbulent flow, Critical velocity and Reynold's number, Continuity equation, Stoke's law, Terminal velocity, Bernoulli equation, Applications of Bernoulli equation, Euler's equation of motion, The Navier-Stoke's equation.	
UNIT - III	**Electrodynamics and Scattering of Radiations**	**(11)**
	Scalar electric potential (or V), Magnetic vector potential ($\vec{A}$), Poisson's and Laplace's equations, Maxwell's equations in vacuum, Electromagnetic waves in vacuum and wave equation, Thomson and Raleigh scattering, Scattering cross section, Explanation for blue of the sky, Red colour of sunset and sunrise.	
UNIT - IV	**The Sun and Solar Activity**	**(11)**
	Magnetic fields, The hot corona, Morphology of active regions, The flare event, The post flare period.	

Course Outcomes: Students should be able to

1. explain the types of fluid and terms related to the fluid.
2. understand Stoke's law, Bernoulli equation and Euler's equation of motion.
3. analyze electrodynamics potentials, EM wave equations, Poisson's and Laplace's equations.
4. Diffentiate the photosphere, the flare and the post flare periods.

References

1. Rutherford, D. E. 1959. Fluid dynamics. Edinburgh: Oliver and Boyd Publications, London
2. Griffiths, David J. 2018. Introduction to electrodynamics.4th edition, PHI Course Pvt. Ltd
3. Piddington, J. H. 1969. Cosmic electrodynamics. 99th Edition, New York: Wiley.
4. Baidhnath Basu, 2014. An Introduction to Astrophysics. PHI Course Pvt. Ltd. New Delhi
6. Harwit, Martin. 2010. Astrophysical concepts.4th edition, New York, NY: Springer.

BPAP 403 Spectroscopy, Magnetism And Electronics

Course Objectives: Students will be able to

1. learn the optical leveling of spectrometer and Schuster's method and to study nature of light.
2. study the spectrums of different sources.
3. study the thickness of Fabry-Perot etalon and wavelength of LASER source.
4. study the Earth's magnetic field and know about angle of dip.
5. learn the inverse square law.
6. study the Planck's constant using LED.

Credits (Total Credit 04)	SEMESTER-IV BPP 403 Thermal Physics, Optics and Lasers	No. of hours per unit/credits
	Group - A	
	1. Calibration of Spectrometer. 2. Measurement and identification of spectral lines. 3. Study of Balmer lines. 4. Band absorption spectrum of liquid ($KMnO_4$ solution). 5. Study of line absorption spectrum and measurement of temperature of sodium flame. 6. Study of solar spectrum. 7. Measurement of thickness of F. P. Etalon. 8. Measurement of wavelength of given LASER source using diffraction grating. 9. Measurement of Earth's magnetic field using Earth inductor.	
	Group - B	
	1. Study of hysteresis curve using CRO. 2. I-V characteristics of solar cell. 3. Verification of inverse square law of intensity. 4. Study of Lissajeous figures using CRO. 5. D. C. amplifier using operational amplifier. 6. Phase shift measurement of RC network using CRO. 7. Verification of Stefan's forth power law. 8. Determination of Planck's constant using LED. 9. Crystal oscillator.	

Course Outcomes: Students should be able to

1. adjust the spectrometer for parallel light.
2. study the $H_{\square}$ and $H_{\square}$ lines of hydrogen spectrum.
3. determine thickness of F. P. etalon and wavelength of He-Ne LASER source.
4. determine horizontal and vertical components of Earth's magnetic field, also angle of Dip.
5. determine the Planck's constant using LED.

REFERENCE BOOKS:

1. B. L. Worsnop and H. T. Flint,1971, Advanced practical Physics for Students, Asia Pub. House. .
2. C. L. Arora , 2009, Practical Physics, S. Chand Publishing New Delhi.Harnam Singh and Dr. P. S. Hemne,2014, B. Sc. Practical Physics, S. Chand (Publishing House Delhi).
3. Dr. S. P. Singh,2012, Advanced Practical Physics Vol. – I, Pragati Prakashan, Meerat.
4. Dr. S. P. Singh , 2012, Advanced Practical Physics Vol. – II, Pragati Prakashan, Meerat.