

**Semester – III**  
**Optics and Electricity I**

<b>Programme Name</b>	B Sc in Physics	Semester	III
<b>Course Title</b>	Optics and Electricity I		
<b>Course Code</b>	BSCPHCS301	<b>No. of Credits</b>	03
<b>Contact Hours</b>	52	<b>Duration of SEA/ Exam</b>	03 h
<b>Formative Assessment Marks</b>	20	<b>Summative Assessment Marks</b>	80

**Program Outcomes (PO):**

- PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
- PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
- PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
- PO-4: Ethics: Apply the professional ethics and norms in respective discipline.
- PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
- PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

<b>Course Learning Outcomes (CO)</b>	<b>Programme Outcomes (Pos)</b>					
	<b>PO- 1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>
<b>At the end of the course students will be able to:</b>						
CO-1: Explain the nature, theory and properties of light	<b>X</b>			<b>X</b>	<b>X</b>	<b>X</b>
CO-2: Describe the interference of light using biprism, air wedge, Newtons rings, Michelson's interferometer.	<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>	<b>X</b>
CO-3: Explain Fresnel and Fraunhofer diffractions of light, describe rectilinear propagation of light and principle and working of Laser.	<b>X</b>	<b>X</b>				<b>X</b>
CO-4: Explain the parts of electrical circuits, circuitary laws, transient response and solve the problems of electrical circuits.	<b>X</b>	<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>
CO-5: Understand and apply various network theorems such as Superposition, Thevenin, Norton, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	<b>X</b>	<b>X</b>			<b>X</b>	<b>X</b>
CO-6: Describe magnetic dipoles, ballistic galvanometer damping, circuit bridges, dielectric parameters.	<b>X</b>				<b>X</b>	

<b>Paper: Optics and Electricity I</b>		Duration
UNIT - I	<p><b>Theories of light:</b> Review of nature and theories of light, properties of light, velocity of light. (2h)</p> <p><b>Interference of light:</b> Coherent sources, Production of coherent sources, Biprism – construction, working and experiment to find wavelength, fringes with white light. Coherent sources by Amplitude division, Colors of thin films in reflected light – theory, theory and experiment of air wedge, Newton’s Rings, Michelson’s interferometer and applications. (11h)</p>	13 h
UNIT - II	<p><b>Diffraction and Laser</b></p> <p><b>Diffraction:</b> Introduction to diffraction- Fresnel and Fraunhofer diffraction. Fresnel’s assumptions- concept of Fresnel’s half period zones – Theory of rectilinear propagation of light – mention of criterion for size of an obstacle. (3h)</p> <p>Fraunhofer diffraction – Single slit, double slit theory, many slits, diffraction grating, theory of normal &amp; oblique incidence, dispersive power, resolution, Rayleigh’s criterion – expression for resolving power of grating and telescope. comparison between prism and grating spectra. Problems. (7h)</p> <p><b>LASER:</b> Introduction to lasing action, properties of Laser light. Principle of Laser – Spontaneous and stimulated emissions of radiation – population inversion, methods of population inversion (qualitative). Three level lasing system. Construction and working of He-Ne Laser. Applications. Problems. (3h)</p>	13 h
UNIT - III	<p><b>Basics of electrical circuits</b></p> <p>Ohm’s law, Active and passive circuits, parts of electrical circuits, ideal voltage and current sources, Source transformation. KVL and KCL. Voltage and current division rules. Problems. (4h)</p> <p><b>Network theorems:</b> Superposition theorem, Thevenin’s &amp; Norton’s theorems - Process of converting the given network into Thevenin equivalent and Norton equivalent. Transforming Thevenin equivalent into Norton’s equivalent and vice versa. Maximum power transfer theorem. (derivation), applications. Problems. (9h)</p>	13 h

UNIT - IV	<b>Transients, Magnetic effect of a current and Dielectrics</b>	13 h
	<b>Transient Currents:</b> Theory of CR circuit (charging and discharging), LR circuit (growth and decay of current), LCR circuit (discharging). Problems. (5h)	
	<b>Magnetic effect of a current:</b> Force acting on a moving charge in electric and magnetic fields - Lorentz force. Force on a current carrying conductor in a magnetic field. Torque on a current loop in a magnetic field. Magnetic dipole moment – Torque on a magnetic dipole. Equivalence of a current loop and a magnetic dipole. Ballistic galvanometer – charge sensitivity – effect of damping. Theory of Andersons bridge & De-Sauty’s bridge. Problems. (5h)	
	<b>Dielectrics:</b> Dielectric basic parameters. Polar and non-polar dielectrics. Various polarization of dielectrics–Expression for total polarization (qualitative). Applications of dielectrics. Problems. (3h)	

#### Reference Books:

1. Fundamentals of Optics – Jenkins and White.
2. Fundamentals of Physics by Halliday, Resnick and Walker.
3. Optics by Brijlal & Subrahmanyam.
4. Physics for degree students by C L Arora & P S Hemne.
5. College Physics by N Sunderajan
6. Optics – Khanna and Gulati.
7. A Text Book of Optics – B K Mathur.
8. A text book of Engineering Physics by M N Avadhanulu, P G Kshirsagar and TVS Arunmurthy

#### List of Experiments to be performed in the Laboratory:

A minimum of 8 experiments are to be carried out in the laboratory. (4 hours per week)

S No.	Name
1	Air wedge; determination of diameter of a wire.
2	Diffraction at straight wire.
3	Diffraction grating by minimum deviation.
4	Resolving power of grating.
5	Biprism- determination of wavelength of sodium light.
6	Self-inductance by Anderson’s bridge.
7	Charge sensitivity of BG
8	Tangent galvanometer; field along axis of a single coil.
9	Network theorems; Thevenin and Nortons theorems
10	Verification of maximum power transfer theorems
11	Charging and discharging of CR circuit.
12	Low resistance by potentiometer
13	$B_H$ by using Helmholtz double coil galvanometer
14	LASER diffraction; determination of grating constant and wavelength of a Laser.
15	Verification of laws of series and parallel combinations of resistors (minimum three resistors combination)
16	Verification of voltage division law and current division law
17	Verification of KVL and KCL

**Semester – III**  
**Discipline elective / optional Paper**

<b>Programme Name</b>	B Sc in Physics	Semester	IV
<b>Course Title</b>	Interdisciplinary Physics		
<b>Course Code</b>	BSCPHE401	<b>No. of Credits</b>	02
<b>Contact Hours</b>	24	<b>Duration of SEA/ Exam</b>	02 h
<b>Formative Assessment Marks</b>	10	<b>Summative Assessment Marks</b>	40

**Program Outcomes (PO):**

- PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
- PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
- PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
- PO-4: Ethics: Apply the professional ethics and norms in respective discipline.
- PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
- PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

<b>Course Learning Outcomes (CO)</b>		<b>Programme Outcomes (Pos)</b>					
<b>At the end of the course students will be able to:</b>		<b>PO- 1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>
i.	Explain geological factors of Earth: Earth crust, surface, magnetism, atmosphere, natural catastrophe.	<b>X</b>	<b>X</b>		<b>X</b>	<b>X</b>	<b>X</b>
ii.	Obtain knowledge and understand biological importance of radiation.	<b>X</b>			<b>X</b>		<b>X</b>
iii.	Explain the principle and working of medical instruments and tools.	<b>X</b>	<b>X</b>	<b>X</b>			<b>X</b>

### **III Semester B Sc Physics (MU) Syllabus**

<b>Discipline Elective (optional): Interdisciplinary Physics</b>		<b>Duration</b>
<b>UNIT - I</b>	<b>Geophysics</b> Climate variations: Internal response, changes in atmosphere, changes in land surface, changes in ocean. The Deeper, the hotter, Earthquakes. Why is the earth hot inside? Upside Down Mountains, Floating Continents, The raise of Mountains, Terrestrial Magnetism, Physics of the atmosphere. Introduction to Seismology: The Earth's interior and crust as revealed by the earth quakes – Rayleigh waves. Tsunami causes and impacts	8 h
<b>UNIT - II</b>	<b>Biophysics</b> Accommodation of the eye, Color Vision, Myopia and hypermetropia astigmatism. Speech and hearing, biological effects of radiation, medical Use of radiation, radioactive isotopes as tracers, Thermodynamics of Life.	8 h
<b>UNIT - III</b>	<b>Medical Physics</b> Introduction to Medical Physics. X-rays: Electromagnetic spectrum, production of X-rays, X-ray diagnostics and imaging. CT Scan, Physics of NMR, NMR imaging, MRI radiological imaging, Ultrasound imaging, Physics of Doppler with applications	8 h

#### **Reference Books:**

1. Physics- Foundation and Frontiers- George Gamow, John M. Cleveland, Prentice-Hall, 1960
2. Garland, Introduction to Geophysics 11th edition, WB Saunder Company, London 1979
3. William Lowrie, Fundamentals of Geophysics 11th edition, Cambridge press, UK.
4. Physics of Radiation Therapy, F M khan- Williams and Wilkins, 3rd Edition, 2003.



<b>Paper: Optics and Electricity II</b>		Duration
UNIT - I	<p><b>Electromagnetic theory</b>            Scalar and vector fields with examples, del operator, gradient of a scalar function. Relation between field and potential. Integration theorems - line integral, surface integral, volume integral. Divergence and curl of a vector - physical significances. Gauss and Stokes' theorems. Problems. (6h)            Equation of continuity - setting up of Maxwell's field equations - concept of displacement current, setting up of wave equations for E &amp; B – velocity of e. m. wave in a dielectric medium – light as e. m. wave - transverse nature of e. m. wave (proof). Poynting theorem – Poynting vector – energy density of e. m. waves. Problems. (7h)</p>	13h
UNIT - II	<p><b>Polarization of light</b>            Plane of vibration &amp; polarization. Double refraction - optic axis. Principal section of a uniaxial crystal. Huygens theory of double refraction. Oblique incidence. Principal refractive index of double refracting crystals. Propagation of plane waves in a uniaxial crystal. Circularly and elliptically polarized light, retarding plates. Theory of quarter wave plate (QWP) and half wave plate (HWP) &amp; uses. (11h)            Optical activity: Fresnel's theory, rotatory dispersion. Problems. (2h)</p>	13h
UNIT - III	<p><b>Alternating current and Filters</b>  <b>Alternating current:</b> Expressions for mean and r.m.s values of alternating voltage and current, j operator, principle of superposition and phasor analysis. Response of LR, CR and LCR circuits to sinusoidal voltages using j operators. Form factor of AC. Series and parallel resonance circuits. Sharpness of resonance – expression for the 'Q' factor, bandwidth – expression for the power. Problems. (9h)  <b>Filters:</b> High and low pass filters using CR and LR circuits, frequency response curves, cutoff frequency, qualitative study of band pass filters. Problems. (4h)</p>	13h
Unit - IV	<p><b>Power transmission and Thermoelectricity</b>  <b>Power transmission:</b> Sources of electric power. Basic structure of power system. 3- phase power transmission. Interconnection – Star or Y connection – Relation between line voltage and phase voltage. Mesh or delta connection – Relation between line current and phase current. Problems. (5h)  <b>Thermoelectricity:</b> Seebeck effect - Thermoelectric series – Thermocouple – Variation of thermo emf with temperature (qualitative). Peltier effect – Peltier coefficient – Relation between Peltier coefficient and thermoelectric power. Thomson effect – Thomson coefficient - Relation between Thomson coefficient and thermoelectric power. Thermoelectric laws. Thermoelectricity applications – Thermopile, Thermoelectric cooler. Problems. (8h)</p>	13h

**Text Books:**

1. Fundamentals of Optics – Jenkins and White.
2. Fundamentals of Physics by Halliday, Resnick and Walker.
3. Optics by Brijlal & Subrahmanyam.
4. Physics for degree students by C L Arora & P S Hemne.
5. College Physics by N Sunderajan
6. Optics – Khanna and Gulati.
7. A Text Book of Optics – B K Mathur.
8. Physics for Degree Students by CL Aurora & PS Hemne (S. Chand & Co)
9. Fundamentals of Magnetism and Electricity by DN Vasudeva (S Chand & Co)
10. Electricity and Magnetism by R Murugesan (S Chand & Co)
11. Electricity and Magnetism by K K Tiwari (S Chand & Co)
12. Electricity and Magnetism by D C Tayal (Himalaya)
13. A text book of Engineering Physics by M N Avadhanulu, P G Kshirsagar and TVS Arunmurthy

**Reference Books:**

1. Physics-Part-II by David Halliday and Robert Resnick (Wiley Eastern Limited)
2. Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition by Edward M Purcell (Tata Mc Graw-Hill Publishing Company Ltd, New Delhi)
3. Physics for Scientists and Engineers by Jewett & Serway (Cengage learning India Pvt Ltd, Delhi)
4. The Feynman Lectures on Physics – Vol II by Richard P Feynman, Robert B Leighton, Mathew Sands, (Narosa Publishing House)

**List of Experiments to be performed:**

A minimum of 8 experiments are to be carried out in the laboratory. (4 hours per week)

1	Newton's ring: Radius of curvature of plano convex lens
2	Verification of superposition Theorem.
3	Low resistance by Carey-Foster bridge
4	Law of combination of capacitance by de-Sauty's bridge.
5	M and C by Carey – Foster bridge
6	Frequency response of Low pass and high pass filters.
7	Self-inductance by phasor diagram and reactance method
8	Parallel resonance – Resonant frequency, bandwidth and quality factor.
9	$B_H$ by using tangent galvanometer
10	High resistance by leakage – BG.
11	Mutual inductance using BG.
12	Earth inductor – $B_H$ , $B_V$ and dip at the place
13	Polarimeter; specific rotation of sugar solution.
14	Diffraction grating by normal incidence method.
15	Dispersive power of a prism.
16	Growth and decay of current in LR circuit.

### **Reference Books for Laboratory Experiments:**

1. Advanced Practical Physics for students by B.L. Flint and H.T. Worsnop (Asia Publishing House.)
2. A Text Book of Practical Physics by I. Prakash & Ramakrishna, 11th Edition (Kitab Mahal)
3. Advanced level Physics Practicals by Michael Nelson and Jon M. Ogborn 4th Edition (Heinemann Educational Publishers)
4. A Laboratory Manual of Physics for undergraduate classes by D. P. Khandelwal (Vani Publications).
5. BSc Practical Physics Revised Ed by CL Arora (S. Chand & Co)
6. An advanced course in practical physics by D. Chattopadhyay, PC Rakshit, B. Saha (New Central Book Agency Pvt Ltd)

**Semester – IV**  
**Discipline Elective / Optional Paper**

<b>Programme Name</b>	B Sc in Physics	Semester	IV
<b>Course Title</b>	Astrophysics and Indian knowledge system		
<b>Course Code</b>	BSCPHE401	<b>No. of Credits</b>	02
<b>Contact Hours</b>	24	<b>Duration of SEA/ Exam</b>	02 h
<b>Formative Assessment Marks</b>	10	<b>Summative Assessment Marks</b>	40

**Program Outcomes (PO):**

- PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas
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<b>Course Learning Outcomes (CO)</b>		<b>Programme Outcomes (PO)</b>					
		<b>PO- 1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>
<b>At the end of the course students will be able to:</b>							
i.	Obtain knowledge and understand the basics of Astrophysics	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
ii.	Explain the birth and evolution of various mass stars.	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
iii	Explain the birth and evolution of Universe using Big bang, Steady state and Pulsating theories.	<b>X</b>			<b>X</b>	<b>X</b>	<b>X</b>
iii.	Gain knowledge of ancient Indian education system, science and technology.	<b>X</b>				<b>X</b>	<b>X</b>

### III Semester

Discipline Elective: Astrophysics and Indian knowledge system		Duration
UNIT - I	<p><b>Stellar coordinates and parameters</b> <b>Astrophysics</b></p> <p><b>Introduction:</b> Explanation about components of solar system, galaxy and universe with distances, Definition of parsec, astronomical unit (AU), light year and their relations. Longitude and latitudes on Earth. Location of MU, Bangalore, Delhi, London on Earth. Celestial coordinates: Parts of celestial sphere, Horizontal system, Equatorial system and ecliptic system. (3h)</p> <p><b>Stellar parameters:</b> Measurement of stellar distance: Trigonometric parallax method (derivation)- distances of neighborhood stars in <math>ly</math> and <math>pc</math>. Brightness of stars: Apparent (<math>m</math>) and absolute magnitude(<math>M</math>) scales. Relation between <math>m</math> and <math>M</math> (distance modulus equation derivation) Brightness - luminosity- distance relation of stars. Spectral classification of stars: relation between spectral type, temperature, mass, life time of stars with examples in comparison with Sun. H-R diagram. (5h)</p>	8h
UNIT - II	<p><b>Evolution of stars and Universe</b></p> <p><b>Birth and evolution of stars:</b> Formation of stars, nuclear fusion reactions in main sequence and red giant stages. Chandrasekhar limit. Birth and evolution of stars - White dwarfs, Neutron stars and Black holes. Qualitative explanation for Supernova explosion, Pulsar and Quasar. (4h)</p> <p><b>Evolution of Universe:</b> Hubble space telescope - James Webb space telescope comparison. Doppler shift of galaxies. Hubble's law. Evolution of the Universe using Big-bang theory. Experimental evidence. Large Hadron collider (LHC) experimental results.Mention of pulsating and steady state theories. Problems. (4h)</p>	8h
UNIT - III	<p><b>Indian knowledge system</b></p> <p><b>Indian basis to Science and Technology:</b> Science - Astronomy. Concept of Matter, Life and Universe. Vedic Cosmology, Sun, Earth, Moon, and Eclipses. Gravity, Velocity of Light, Sage Agastya's Model of Battery, Vimāna: Aeronautics. Concepts of Zero and Pi, Glass and Pottery, Metallurgy, Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Iron Pillar of Delhi, Famous Indian scientists and their achievements (C V Raman, M N Saha, Homi J Bhabha, S N Bose, Vikram Sarabhai and so on). (8h)</p>	8h

## Reference Books:

1. Chandrashekar and his limits By Venkaraman, Universities press
2. Structure of the universe by Jayant Narlikar, Oxford University press
3. Astronomy- The Evolution of the universe, Michel Zeilik, John Wiley and Sons
4. Theoretical Astrophysics T Padmanabhan (Three volumes) Cambridge University press
5. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,
6. History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata (2014).
7. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006).
8. Vedic Physics by Keshav Dev Verma, Motilal Banarsidass Publishers (2012).
9. India's Glorious Scientific Tradition by Suresh Soni, Ocean Books Pvt. Ltd. (2010).

**Semester – IV**  
**Compulsory Skill / Practical**  
**Maintenance of Optical - Electrical – Electronic equipments / devices**

Programme Name	B Sc in Physics	Semester	IV
Course Title	Maintenance of Optical - Electrical – Electronic equipments / devices		
Course Code	BSCPHIS401	No. of Credits	02
Contact Hours	24	Duration of SEA/ Exam	Viva-Voce
Formative Assessment Marks	10	Summative Assessment Marks	40

**Program Outcomes (PO):**

- PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
- PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
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Course Outcomes (CO)	Programme Outcomes (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
After Successful completion of the course, the students will be able to						
1. Understand and explain various laws propagation of light and electrical circuits.	X	X		X	X	X
2. Obtain the knowledge about the structure of electrical and electronic devices.	X	X		X	X	X
3. Demonstrate practical use of electrical and electronic circuits.	X			X	X	X
4. Obtain a skill of repairing electrical/ electronic equipments / home appliances	X	X		X	X	X

<b>Maintenance of Optical - Electrical – Electronic equipments / devices</b>		<b>Duration</b>
UNIT - I	<p>Basics of geometrical optics. Convex and concave lenses / mirrors. Principle, working and maintenance of travelling microscope, biological microscope, spectrometer, reflector and refractor telescopes.</p> <p>Drone and CC camera working principle and maintenance.</p> <p>Basics of Electricity - Electric current, Ohms law, emf, Electric Power, KWh, generator, reactance, impedance, capacitor, inductor, choke &amp; transformer. Introduction to Current and voltage measuring instruments: AC &amp; DC Ammeter, AC &amp; DC Voltmeter, watt hour meter, Potentiometer, Multi meter.</p>	8h
UNIT - II	<p>Working of switches (1-way 2-way), Principle and working of regulator, principle and working of starter and chokes, Domestic wiring - Application of Fuses, ELCB (Earth Leakage Circuit Breaker) Principle and working of lightning arrester-precautions during lightning-, Principle and working of Iron box, Mixer grinder-induction coil- Principle and working of filament bulb, tube light and LED bulbs, Working of ceiling &amp; table fan, working of Mixer and Grinder, Working of Fridge/ AC/- washing machine. Smart electrical devices</p>	8 h
UNIT - III	<p>Working principles of regulated power supply, function generators. Use of CRO –Measurement of frequency/voltage/phase difference. Basic working principle of Radio/TV. Mobile phones – Chargers. Remote controllers – Bluetooth - 2G/3G/5G. Concept of GPRS. Digital devices – digital measuring instruments-digital display-Digital Camera-Resolution–Pixels-advantages and limitations-Digital Zoom-Optical Zoom. Digital storage devices- Pen drive.</p>	8 h