MANGALORE UNIVERSITY
Suggested programme structure for the Under Graduate Programme
Bachelor of Science (B. Sc.)

Semester	*Course 1	*Course 2	*Course 3	**Elective / Optional	Course	***Languages	****Compulsory	Total Credit	Total working hour
I	5 (3T+2P)	5 (3T+2P)	5 (3T+2P)			3+3	2	23	4+4+4+4+4+4 +4+4+2 = 34
II	5 (3T+2P)	5 (3T+2P)	5 (3T+2P)			3+3	2	23	4+4+4+4+4+4 +4+4+2 = 34
III	5 (3T+2P)	5 (3T+2P)	5 (3T+2P)	2		3+3		23	4+4+4+4+4+4 +2+4+4=34
IV	5 (3T+2P)	5 (3T+2P)	5 (3T+2P)	2		3+3	2	25	4+4+4+4+4+4 +2+4+4+2=36
V	8 [(2x3T) +2P]	8[(2x3T) +2P]	8 [(2x3T) +2P]				2	26	3+3+4+3+3+4 +3+3+4+2=32
VI	8 [(2x3T) +2P]	8 [(2x3T) +2P]	8 [(2x3T) +2P]				2	26	3+3+4+3+3+4 +3+3+4+2=32
								146	**202**

Note:

* Course 1 / * Course 2 / * Course 3: I to IV semestersTheory:3 credit = 4 contact hours
Practicals:2 credit = 4 contact hours
* Course 1 / * Course 2 / * Course 3: V to VI semesters Theory:2 credit = 3 contact hours &
Practicals:2 credit = 4 contact hours
**Elective / Optional: 2 credit = 2 contact hours
***Languages: 3 credit = 4 contact hours
****Compulsory: 2 credit = 2/3 contact hours

MANGALORE UNIVERSITY
B. Sc. SEP 2024
COURSE PATTERN AND SCHEME OF EXAMINATION
CORE SUBJECT: PHYSICS

Core/ Elective	Course Code	Title	Instruction hours/Week	Duration of the Exam (hours)	Max. Marks			Credits
					IA	Exam	Total	
I Semester								
Group I Core Subject	BSCPHCS 101	Mechanics & properties of matter	4	3	20	80	100	3
	BSCPHPS 101	Practicals - Mechanics & properties of matter	4	3	10	40	50	2
Total Number of Credits for Core Subject (Physics) in I Semester: 5								
II Semester								
Group I Core Subject	BSCPHCS 201	Acoustics, Relativity & Thermal Physics	4	3	20	80	100	3
	BSCPHPS 201	Practicals - Acoustics, & Thermal Physics	4	3	10	40	50	2
Total Number of Credits for Core Subject (Physics) in II Semester: 5								
III Semester								
Group I Core Subject	BSCPHCS301	Optics & Electricity I	4	3	20	80	100	3
	BSCPHPS 301	Practicals - Optics & Electricity I	4	3	10	40	50	2
Group II Discipline Elective (optional)	BSCPHES 301	Interdisciplinary Physics	2	2	10	40	50	2
Total Number of Credits for Core subject (Physics) in III Semester: 5 Discipline elective: 02								
IV Semester								
Group I Core Subject	BSCPHCS 401	Optics & Electricity II	4	3	20	80	100	3
	BSCPHPS 401	Optics & Electricity II	4	3	10	40	50	2
Group II Discipline Elective (optional)	BSCPHES 401	Astrophysics and Indian knowledge system	2	3	10	40	50	2
Compulsory Skill/ Practicals	BSCPHIS 401	Maintenance of Optical - electrical - electronics instruments	2	Viva-voce	10	40	50	2
Total Number of Credits for Core subject (Physics) in IV Semester: 5 Discipline elect. Opt.: 2 Compulsory skill / practical: 2								
V Semester								
Group I Core Subject	BSCPHCS 501	Quantum Mechanics & Spectroscopy	4	3	20	80	100	3
	BSCPHCS 502	Condensed matter Physics	4	3	20	80	100	3
	BSCPHPS 501	Practicals – Modern Physics	4	3	20	80	100	2
Total Number of Credits for Core Subject (Physics) in V Semester: 8								
VI Semester								
Group I Core Subject	BSCPHCS 601	Nuclear Physics	4	3	20	80	100	3
	BSCPHPS 602	Electronics	4	3	20	80	100	3
	BSCPHPS 601	Practicals – Nuclear Physics & Electronics	4	3	20	80	100	2
Total Number of Credits for Core Subject in VI Semester: 8								
Total number of Credits for Core Subject (Physics) from I - VI Semesters: 36 Discipline elective: 4, Compulsory skill / practical: 2								

Note: The theory IA will be based on the average of two internal tests. The Practical IA will be based on regular performance and one model test.

Mangalore University
SEP 2024 B Sc Physics syllabus structure

<table>
<tr>
<td>

B Sc I Semester

- Paper Title: Mechanics & properties of matter
- Paper Code: BSCPHCS101
- Unit distributions:
  Unit 1: Newtonian mechanics, review of vectors, gravitation law
  Unit 2: Rotation dynamics,rigid body
  Unit 3: Properties of matter, elasticity
  Unit 4: Fluid mechanics
- Practical title: Mechanics & properties of matterPractical Code: BSCPHPS101

</td>
<td>

B Sc II Semester

- Paper Title: Acoustics, Relativity & Thermal PhysicsPaper Code: BSCPHCS201
- Unit distributions:
  Unit 1: Acoustics, Fourier theorem
  Unit 2: Relativity
  Unit 3: Thermodynamics
  Unit 4: Thermal radiation
- Practical title: Acoustics & Thermal Physics
- Practical Code: BSCPHPS201

</td>
</tr>
<tr>
<td>

B Sc III Semester

- Paper Title: Optics& Electricity I
- Paper Code: BSCPHCS301
- Unit distributions:
  Unit 1: Review of theories of light, Interference
  Unit 2: Diffraction& LASER
  Unit 3: Network elements & theorems
  Unit 4: Transients, electrical measurements & dielectrics
- Practical title: Optics & Electricity I
- Practical code: BSCPHPS301

</td>
<td>

B Sc IV Semester

- Paper Title: Optics &Electricity II
- Paper Code: BSCPHCS401
- Unit distributions:
  Unit 1: Electromagnetic theory
  Unit 2: Polarization
  Unit 3: Alternating current and filters
  Unit 4: Thermo electricity & power transmission
- Practical title: Optics & Electricity II
- Practical Code: BSCPHPS401

</td>
</tr>
<tr>
<td>

B Sc V Semester (2 papers)

- **Paper 1 title**: Spectroscopy & Quantum Mechanics
- Paper code: BSCPHCS501
- Unit distributions:
  Unit 1: Development of Quantum mechanics
  Unit 2: Quantum Mechanics
  Unit 3: Atomic Models & Spectra
  Unit 4: Molecular Spectra, Scattering
- **Paper 2 title**: Condensed matter Physics
- Paper code: BSCPHCS502
- Unit distributions:
  Unit 1: Statistical Physics, specific heat of solids & nano materials
  Unit 2: X - ray Crystallography and Super conductivity
  Unit 3: Band theory of solids
  Unit 4: Semiconductor Physics
- Practical title: Modern Physics
- Practical Code: BSCPHPS501

</td>
<td>

B Sc VI Semester(2 papers)

- **Paper 1 title**: Nuclear Physics
- Paper code: BSCPHCS601
- Unit distributions:
  Unit 1: Nuclear properties, radioactivity
  Unit 2: Nuclear decay & spectra of nuclear radiation
  Unit 3: Nuclear force, nuclear reaction and nuclear reactors
  Unit 4: Particle accelerators & detectors and fundamental particles
- **Paper 2 title**: Electronics
- Paper code: BSCPHCS602
- Unit distributions:
  Unit 1: BJT and FET amplifiers
  Unit 2: OPAMP & Oscillators
  Unit 3: Regulated Power Supply and Communication Electronics
  Unit 4: Digital Electronics
- Practical title: Nuclear Physics & Electronics
- Practical Code: BSCPHPS601

</td>
</tr>
</table>

B Sc III Semester Discipline Elective optional	B Sc IV Semester Discipline Elective optional
➢ Paper Title: Interdisciplinary Physics ➢ Paper Code: BSCPHES301 ➢ Unit distribution Unit I : Geophysics Unit II : Biophysics Unit III: Medical Physics	➢ Paper Title: Astrophysics and Indian ➢ knowledge system ➢ Paper Code: BSCPHES401 ➢ Unit distributions: Unit I:Stellar coordinates and parameters Unit II : Evolution of stars and Universe Unit III: Indian knowledge system
B Sc IV Semester compulsory skill / practicals ➢ Paper Title: Maintenance of Optical - Electrical - Electronics instruments ➢ Paper Code: BSCPHIS401 ➢ Objective: Departmental internship to enhance students' skills.	

MANGALORE UNIVERSITY

SYLLABUS FOR BSc PHYSICS SEP 2024

Semester – I

Mechanics and properties of matter

Programme Name	B Sc in Physics	Semester	I
Course Title	Mechanics & properties of matter		
Course Code	BSCPHCS101	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 h
Formative Assessment Marks	20	**Summative Assessment Marks**	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, give and receive clear instructions.

Course Learning Outcomes (CO)		**Program outcomes (POs)**					
At the end of the course students will be able to:		**PO- 1**	**PO-2**	**PO-3**	**PO-4**	**PO- 5**	**PO- 6**
i.	Estimate the possible error in measurement of a physical quantity, using its dimensional equation, the least counts of instruments used and by actual measurements in the appropriate system of units.	**X**	**X**	**X**		**X**	**X**
ii.	Apply laws of conservation of momentum and associated energy along with laws to motion to the systems of linear/rotational motion to determine different parameters associated with physically rigid bodies.	**X**	**X**	**X**			
iii.	Capable of determining various elastic moduli of materials.	**X**	**X**	**X**		**X**	
iv.	Apply the concept of rotational dynamics and simple harmonic motion in various applications.	**X**	**X**		**X**		
v	Explain bending of beams and use of torsion pendulum in the determination of various physical parameters.	**X**	**X**				**X**
vi	Measure surface tension and factors affecting surface tension of liquids and hence measurement of viscosity liquids.	**X**	**X**		**X**		**X**

I Semester B Sc Physics (MU) Syllabus

Paper: Mechanics and properties of matter		Duration
UNIT - I	**Mechanics:** Units and dimensions, Review of scalars and vectors. Derivative of a planar vector of constant magnitude but changing direction. Deduction of the results of uniform circular motion.Problems. (4h) Review of Newtonian mechanics: Newton's laws of motion, Concepts of inertia, force, momentum and energy. (2h) Conservation laws – linear and angular momentum and energy with examples, circular motion – central forces, centripetal and centrifugal forces with examples. Planetary motion- orbital motion, Kepler's laws (derivation). - Projectile motion with examples - escape velocity. Satellite motion, rockets, single and multistage rockets- rocket fuel, rocket shape, time period of the satellite, different types of satellites, shapes of the orbits of satellites motion. Launching of satellites, re-entry problems. Problems. (7h)	13 h
UNIT - II	**Rigid body mechanics:** Moment of inertia and radius of gyration. Theorems of moment of inertia – parallel and perpendicular axes theorems with proof. Calculation of MI of regular and irregular shaped bodies - rectangular lamina, thin rod, circular disc (about different axes). Problems. (7h) **SHM**: Review of simple pendulum, Vertical oscillations of the light loaded spring, expression for force constant. Problems. (2h) **Theory of compound pendulum**: Expression for time period. Reversibility of center of oscillation and center of suspension. Bar pendulum, determination of g and K. Problems. (4h)	13 h
UNIT - III	**Elasticity**: Definition for elasticity, stress and strain, elastic limit, Hooke's law, stress – strain diagram, Elastic constants q, k and n - definition (Mention of practical applications) Derivation of the relation connecting the elastic constants. Poisson's ratio – definition and derivation of limiting values (Mention of practical applications). Work done in stretching a wire, work done during twisting a wire, Derivation of expression for twisting couple on a cylinder. (7h) **Bending of beams**: Explanation, explanation of uniform and non- uniform bending with examples, definition for bending moment, derivation of the expression for bending moment, cantilever bending explanation with examples, Expression for the depression produced at the loaded end of light cantilever. I-section Girders. (Mention of practical applications). Problems. (6h)	13h
UNIT - IV	**Fluid dynamics:** Review of fluid and its properties with examples**.** Streamline flow, turbulent flow (examples) - critical velocity, Equation of continuity, Bernoulli's principle and its applications. (2h) **Surface tension**: Attractive forces in a liquid –forces on the surface of a liquid- Definition of surface tension, molecular theory of surface tension - Surface energy, relation between surface tension and surface energy, illustrations of surface tension - pressure difference across curved surface- examples, excess pressure inside spherical liquid drop, discussion of angle of contact- special cases, Surface tension by drop weight method, factors affecting surface tension; Interfacial surface tension – determination	13h

	interfacial tension by drop weight method. Problems. (6h) **Viscosity:** Coefficient of viscosity – importance of viscosity with examples - determination of coefficient of viscosity by Poisulle's method (derivation) – terminal velocity- importance of terminal velocity -Stoke's law – Stoke's method for the determination of coefficient of viscosity (derivation), (Mention of practical applications). Problems. (5h)	

Text Books:

1. Mechanics by, D. S. Mathur (S. Chand & Co.)
2. Mechanics and Relativity, 3rd Edition by Vidwan Singh Soni (PHI Learning Pvt. Ltd.)
3. Mechanics Berkeley Physics Course, Vol.1 by Charles Kittel, et.al. (Tata McGraw-Hill)
4. Physics for Degree Students by CL Aurora & PS Hemne (S. Chand & Co)
5. Mechanics by J C Upadhyaya (Himalaya Publishing House)
6. A Treatise on Heat by Meghnad Saha, and B. N. Srivastava, (Indian Press)
7. Heat, Thermodynamics and Statistical Physics by Brij Lal, Subrahmanyam and Hemne (S. Chand & Co.)

Reference Books:

1. Principles of Physics 9th Edition by Resnick, Halliday & Walker (Wiley)
2. Introduction to Special Theory of Relativity by Robert Resnick (Wiley Student Edition)
3. Physics for Scientists and Engineers by Jewett &Serway (Cengage learning India Pvt Ltd, Delhi)
4. The Feynman Lectures on Physics – Vol 1 by Richard P Feynman, Robert B Leighton, Mathew Sands, (Narosa Publishing House)
5. Concepts of Modern Physics by Arthur Beiser (Tata McGraw Hill)
6. Modern Physics by Kenneth Krane (Wiley)
7. Newtonian Mechanics by AP French (Viva Books)
8. Modern Physics by G Aruldhas & P Rajagopal (PHI Learning Pvt. Ltd)

List of Experiments to be performed:

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

1	Verification of parallel and perpendicular axis theorems.
2	Determination of MI and mass of Fly Wheel.
3	Law of conservation of liner momentum by collision in two dimensions.
4	Determination of g and K using bar pendulum (two-hole method and h - T graph).
5	Determination of g by spiral spring.
6	Uniform bending – measurement of q
7	Torsion Pendulum –moment of inertia of irregular body.
8	Acceleration due to gravity, from the L – T^2 graph, for a simple pendulum.
9	Effect of mass of the bob on the time period of the simple pendulum.
10	Effect of amplitude of oscillation on the time period of the simple pendulum.

11	Inclined plane – Dependence of downward force on angle of inclination.
12	Cantilever bending – Determination of q.
13	Surface tension by drop weight method.
14	Rigidity modulus using torsion pendulum.
15	Determination of q by Koenig's Method.
16	Interfacial tension between water and kerosine.
17	Searle's double bar – determination of q, n and σ.
18	Rigidity modulus by static Torsion.
19	Viscosity by Stoke's method.
20	Viscosity by Poiseuille's method
21	Viscosity by Oswald Viscometer
22	Determination of q by stretching of wire.

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 – II
Acoustics, Relativity and Thermal Physics

Programme Name	B Sc in Physics	Semester	II
Course Title	Acoustics, Relativity and Thermal Physics		
Course Code	BSCPHYC151	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 hours
Formative Assessment Marks	20	**Summative Assessment Marks**	80

Programme Outcomes (POs)

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.

Course Learning Outcome (CO)	**Program Outcomes (POs)**					
At the end of the course students will be able to:	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1: Apply the concept of the relative motion of frame of reference with appropriate postulates of the theory of relative motion to the measurement of length, time, mass, energy and velocity.	**X**	**X**				**X**
CO-2: Apply the laws of thermodynamics and concept of heat engine to various observations.	**X**	**X**	**X**	**X**	**X**	**X**
CO-3: Explain fundamental laws of black body spectrum.	**X**	**X**	**X**	**X**	**X**	**X**
CO-4: Explain free, damped and forced oscillations, progressive waves & Fourier analysis of square wave.	**X**	**X**			**X**	**X**

II Semester B Sc Physics (MU) Syllabus

Paper: Acoustics, Relativity and Thermal Physics		Duration
UNIT - I	**Oscillations and Waves** **Free and forced oscillations**: Equation for a harmonic oscillator. Free oscillations and damped oscillations (practical examples). Setting up of equation for forced oscillations and its solution, condition for resonance. Problems. (4h) **Waves**: Review of waves - Different types of waves (examples), Equation for a progressive wave in one dimension. Differential equation of wave motion, characterization of simple harmonic waves (frequency, wavelength, amplitude, phase, etc. both in graphical and mathematical), applications of waves. **Propagation of waves**: a) Longitudinal waves: i) Through fluid - Expression for velocity of longitudinal waves (derivation) – examples - Newton`s formula for velocity of sound in airand Laplace correction. ii) Through solid -Vibrations in a rod. b) Transverse waves: Velocity of transverse vibrations in a string (derivation). Expression for fundamental frequency and overtones (examples). Problems. (6h) **Fourier's theorem**: Statement and explanation– expression for Fourier coefficients (exponential form). Limitations of Fourier theorem. Mathematical analysis of a square wave (examples). Problems. (3h)	13 h
UNIT - II	**Relativity** **Frame of reference:** Inertial and non - inertial frames (examples**).** Galilean principle of relativity, Galilean transformation equation. space and time invariance, velocity addition theorem in inertial frames. Concept of fictitious forces with examples. Problems. (4h) **Concept of absolute frame of reference**: Ether hypothesis. Velocity of light and failure of Galilean concepts. (2h) **Special theory of relativity**: Postulates of special theory of relativity. Lorentz transformation (no derivation). Length contraction. Relativity of simultaneity. Time dilation- Twin paradox, Relativistic mass (mention), velocity addition theorem. Einstein's mass energy equivalence- (derivation based on photon gun experiment). Relativistic expression for kinetic energy. Relation between energy and momentum. Rest mass of the photon. Problems. (7h)	13 h

UNIT - III	**Thermodynamics** **Thermal Physics:** Review of gas equation, energy temperature relation.Types of thermal processes. Isothermal, adiabatic, reversible and irreversible (examples). Expression for work done during isothermal and adiabatic processes (examples). Problems. (3h) I law of thermodynamics. Carnot's engine: Carnot's cycle. Efficiency of Carnot's engine. Reversibility of Carnot's engine (mention of practical engines). Refrigerator (principle only), Coefficient of performance. Derivation of Clausius - Clapeyron first latent heat equation and applications. II law of thermodynamics: Kelvin's and Clausius Statements (mention of practical examples). Problems. (7h) **Entropy**: Change in entropy during isothermal, adiabatic, reversible and irreversible processes (examples). T-S diagram of Carnot's cycle. Problems. (3h)	13 h
UNIT - IV	**Low temperature Physics and Radiation** **Low temperature Physics**: Ideal and real gases, liquefaction of gases (examples). Results of Andrews experiment. Joule - Thomson Effect, J - T porous plug experiment: Boyle temperature, inversion temperature and critical temperature - relation. Adiabatic demagnetization. Cryogenics. Measurements of low temperature. Problems. (5h) **Radiation**: Concept of black body, Black body radiation, energy distribution in a black body radiation. Wien's displacement law, Stefan-Boltzmann law, Wien's distribution law and Rayleigh-Jeans law. Planks hypothesis of radiation, Planks explanation of black body radiation. Derivation of Planck's law of black body radiation. Deduction of Wien's distribution law, Rayleigh-Jeans law from Planck's law. Problems. (8h)	13 h

References books:

1. Waves and Oscillations by A. P. French.
2. Fundementals of Physics by Halliday Resnik and Walker,Wiley publications
3. Mechanics by D S Mathur S Chand publication
4. Properties of matter By Brijlal and Subramanyam, S Chand publication
5. Physics for degree students By C L Arora and P S Hemne, S Chand publication
6. College physics by N Sundarrajan:United publisher
7. Mechanics by J C Upadhyaya Himalaya publishing house Pvt Ltd.
8. Modern Physics by R Murugeshan and Kiruthiga Sivaprasath. S Chand publication

List of Experiments to be performed:

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

1	Velocity of sound using sonometer.
2	Frequency of ac using sonometer.
3	Study of Lissajous figures.
4	Frequency of AC by Melde's experiment
5	Specific heat of liquid by cooling.
6	Specific heat of liquid by electrical method.
7	Specific heat of a solid.
8	Platinum resistance thermometer.
9	Thermocouple – Determination thermo-emf.
10	Helmholtz's Resonator.
11	Fourier analysis of square wave.
12	Damped oscillations – Measurement of Q factor
13	Stefan - Boltzmann law.
14	Planck's constant using LED

Semester – III
Optics and Electricity I

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

Course Learning Outcomes (CO)	**Programme Outcomes (Pos)**					
At the end of the course students will be able to:	**PO- 1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1: Explain the nature, theory and properties of light	**X**			**X**	**X**	**X**
CO-2: Describe the interference of light using biprism, air wedge, Newtons rings, Michelson's interferometer.	**X**	**X**		**X**	**X**	**X**
CO-3: Explain Fresnel and Fraunhofer diffractions of light, describe rectilinear propagation of lightand principle and working of Laser.	**X**	**X**				**X**
CO-4: Explain the parts of electrical circuits, circuitary laws, transient response and solve the problems of electrical circuits.	**X**	**X**	**X**		**X**	**X**
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.	**X**	**X**			**X**	**X**
CO-6: Describe magnetic dipoles, ballistic galvanometer damping, circuit bridges, dielectric parameters.	**X**				**X**	

Paper: Optics and Electricity I		Duration
UNIT - I	**Theories of light:** Review of nature and theories of light, properties of light, velocity of light. (2h) **Interference of light**: 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)	13 h
UNIT - II	**Diffraction and Laser** **Diffraction:**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) Fraunhofer diffraction – Single slit, double slit theory, many slits, diffraction grating, theory of normal & oblique incidence, dispersive power, resolution, Rayleigh's criterion – expression for resolving power of grating and telescope. comparison between prism and grating spectra. Problems. (7h) **LASER:** 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)	13 h
UNIT - III	**Basics of electrical circuits** 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) **Network theorems**: Superposition theorem, Thevenin's & 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)	13 h

UNIT - IV	**Transients, Magnetic effect of a current and Dielectrics** **Transient Currents**: Theory of CR circuit (charging and discharging), LR circuit (growth and decay of current), LCR circuit (discharging). Problems. (5h) **Magnetic effect of a current**: 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) **Dielectrics**: Dielectric basic parameters. Polar and non-polar dielectrics. Various polarization of dielectrics–Expression for total polarization (qualitative). Applications of dielectrics. Problems. (3h)	13 h

Reference Books:

1. Fundamentals of Optics – Jenkins and White.
2. Fundamentals of Physics by Halliday, Resnick and Walker.
3. Optics by Brijalal & 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

Programme Name	B Sc in Physics	Semester	IV
Course Title	Interdisciplinary Physics		
Course Code	BSCPHES401	**No. of Credits**	02
Contact Hours	24	**Duration of SEA/ Exam**	02 h
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.

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.

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

III Semester B Sc Physics (MU) Syllabus

Discipline Elective (optional): Interdisciplinary Physics		Duration
UNIT - I	**Geophysics** 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
UNIT - II	**Biophysics** 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
UNIT - III	**Medical Physics** 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.

Semester – IV
Optics and Electricity II

Programme Name	B Sc in Physics	Semester	IV
Course Title	Optics and Electricity II		
Course Code	BSCPHCS401	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 h
Formative Assessment Marks	20	**Summative Assessment Marks**	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.

Course Learning Outcomes (CO)		**Programme Outcomes (PO)**					
At the end of the course students will be able to:		**PO- 1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
i.	Know the basics of electromagnetic theory and apply the ideas to solve the problems related to electromagnetic radiation.	**X**	**X**		**X**	**X**	**X**
ii.	Understand the theories describing the polarization of light, devices and methods producing polarized light and concept of optical activity.	**X**				**X**	**X**
iii.	Understand and apply various concepts of ac fundamentals and use them in solving problems of ac circuits.	**X**	**X**	**X**		**X**	**X**
iv.	Know phase relationship, frequency response ofelectrical circuits consisting of R, L, C connected to AC and understand the condition for resonance, signal passing in filters.	**X**	**X**		**X**	**X**	**X**
v.	Describe the fundamentals of power transmission.	**X**				**X**	**X**
vi	Explain the formation of thermoelectricity using relevant theories and able to solve problems of thermoelectricity.	**X**	**X**	**X**	**X**	**X**	**X**

Paper: Optics and Electricity II		Duration
UNIT - I	**Electromagnetic theory** 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 & 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)	13h
UNIT - II	**Polarization of light** Plane of vibration & 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) & uses. (11h) Optical activity: Fresnel's theory, rotatory dispersion. Problems. (2h)	13h
UNIT - III	**Alternating current and Filters** **Alternating current**: Expressions for mean andr m s valuesof alternatingvoltage 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) **Filters**: High and low pass filters using CR and LR circuits, frequency response curves, cutoff frequency, qualitative study of band pass filters. Problems. (4h)	13h
Unit - IV	**Power transmission and Thermoelectricity** **Power transmission:** 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) **Thermoelectricity:** 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. Thermo electric laws. Thermoelectricity applications – Thermopile, Thermoelectric cooler. Problems. (8h)	13h

Text Books:

1. Fundamentals of Optics – Jenkins and White.
2. Fundamentals of Physics by Halliday, Resnick and Walker.
3. Optics by Brijalal& 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 Murugeshan (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

Programme Name	B Sc in Physics	Semester	IV
Course Title	Astrophysics and Indian knowledge system		
Course Code	BSCPHES401	**No. of Credits**	02
Contact Hours	24	**Duration of SEA/ Exam**	02 h
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.
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.

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

III Semester

Discipline Elective: Astrophysics and Indian knowledge system		Duration
UNIT - I	**Stellar coordinates and parameters** **Astrophysics** **Introduction**: 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 co-ordinates: Parts of celestial sphere, Horizontal system, Equatorial system and ecliptic system. (3h) **Stellar parameters**: Measurement of stellar distance: Trigonometric parallax method (derivation)- distances of neighborhood stars in *ly* and *pc*. Brightness of stars: Apparent (m) and absolute magnitude(M) scales. Relation between m and M (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)	8h
UNIT - II	**Evolution of stars and Universe** **Birth and evolution of stars**: 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) **Evolution of Universe**: 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)	8h
UNIT - III	**Indian knowledge system** **Indian basis to Science and Technology**: 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)	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,MichelZeilik,John Wiley and Sons
4. Theoritical Astrophysics T Padmanabhan(Three volumes) Cambridge University press
5. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,
6. Histrory 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.

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.

Course Outcomes (CO)	**Programme Outcomes (PO)**					
After Successful completion of the course, the students will be able to	**PO- 1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
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**

Maintenance of Optical - Electrical – Electronic equipments / devices		Duration
UNIT - I	Basics of geometrical optics. Convex and concave lenses / mirrors. Principle, working and maintenance of travelling microscope, biological microscope, spectrometer, reflector and refractor telescopes. Drone and CC camera working principle and maintenance. Basics of Electricity - Electric current, Ohms law, emf, Electric Power, KWh, generator, reactance, impedance, capacitor, inductor, choke & transformer. Introduction to Current and voltage measuring instruments: AC & DC Ammeter, AC & DC Voltmeter, watt hour meter, Potentiometer, Multi meter.	8h
UNIT - II	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 & table fan, working of Mixer and Grinder, Working of Fridge/ AC/- washing machine. Smart electrical devices	8 h
UNIT - III	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.	8 h

Semester – V
Quantum Mechanics and Spectroscopy

Programme Name	B Sc in Physics	Semester	V
Course Title	Quantum mechanics and Spectroscopy		
Course Code	BSCPHCS501	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 h
Formative Assessment Marks	20	**Summative Assessment Marks**	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.

Course Learning Outcomes (CO)		**Programme Outcomes (PO)**					
At the end of the course students will be able to:		**PO- 1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
i.	Explain Dual nature of matter with aid of number of experimental results.	**X**	**X**		**X**	**X**	**X**
ii.	Describe fundamentals of Quantum mechanics: Wave function, setting of Schrodinger wave equations, normalization of wave functions, expectation values, Eigen values and functions.	**X**	**X**		**X**		**X**
iii.	Explain atomic models, quantum numbers associated with vector atom model, selection rules, coupling schemes, Bohr magneton, Stern-Gerlach experiment, Zeeman effect.	**X**	**X**		**X**	**X**	**X**
iv.	Explain molecular spectra, rotational spectra, vibrational spectra, electronic spectra and their applications.	**X**			**X**		**X**
v	Describe scattering of light: Rayleigh scattering, Raman scattering their applications in solving specific problems.	**X**	**X**		**X**		**X**

Paper 1: Quantum Mechanics and Spectroscopy		Duration
Unit - I	**Foundation of Quantum mechanics** Evidences of Quantum nature of light: Photoelectric effect (Einstein's equation only), Compton effect – expression for Compton shift using relativistic expressions for momentum and energy. Problems. (3h) Wave nature of particles: De-Broglie waves, Phase and group velocity of waves, Davisson and Germer experiment. Principle of electron microscope, difference between optical and electron microscope. Uncertainty principle, three sets of uncertainty relations, γ-ray microscope. Application of uncertainty relation – estimation of width of spectral lines, impossibility of the existence of electrons inside the nucleus. Problems. (10h)	13h
Unit - II	**Quantum Mechanics** Wave function, need to represent wave function in a complex form, properties of wave function. Setting up of time dependent Schrodinger wave equation and to arrive at the time independent wave equation. Expectation values. Eigen values and Eigen functions. Normalization of wave functions. Solution of Schrodinger equation (i) for a free particle (ii) a particle in a one-dimensional box. Graphs of ψ and $\|\psi\|^2$. Extension to three-dimensional box.Degeneracy.Problems. One dimension alharmonic oscillator (qualitative), zero-point energy of harmonic oscillator-using uncertainty principle. (13 h)	13 h
Unit-III	**Atomic models and spectra** Atomic models, Concept of Spatial & spin quantization of electrons. Different quantum numbers associated with vector atom model, spectral terms and their notations, selection rules, coupling schemes, L-S and J-J coupling. Pauli's exclusion principle. Expression for maximum number ofelectrons in an orbit. Fine structure of Sodium D-line, Larmour precession, Bohr magneton, Stern-Gerlach experiment. Zeeman effect, experimental study of Zeeman effect, theory of normal Zeeman effect. (13h)	13 h

Unit IV	**Molecular Spectra & Scattering** Different regions of molecular spectra, pure rotational spectra of diatomic molecules,vibrationalrotationalspectra ofdiatomicmolecules,electronicspectra. Theory of origin of pure rotational spectra – rigid rotator. Theory of origin of pure vibration spectra.Application of molecular spectra. Electronic spectra of molecules, Fluorescence & phosphorescence. Problems. (6h) Coherent & incoherent scattering. Rayleigh scattering.Blue color of the sky. Raman effect. Experimental arrangement, quantum theory of Raman effect, characteristic properties of Raman lines. Intensity, depolarization ratio of Raman lines. Comparison of Raman shift with IR spectra, rule of mutual exclusion, applications Raman effect diatomic & triatomic molecules. Raman scanner.Laser- Raman spectroscopy. Problems. (7h)	13 h

Books for Reference:

1. Concepts of Modern Physics 6th Edn.–Arthur Beiser
2. Introduction to Atomic and Nuclear Physics 5th Edn–Semat & Albright
3. Modern Physics–Kenneth S Krane
4. Fundamentals of Molecular spectroscopy, 4thEdn–Banwell
5. Quantum Physics–APFrench
6. Quantum Physics,Vol IV–E Wichman, Berkeley Physics Course
7. Quantum Physics – Gasorovicz
8. Modern Physics – Murugeshan
9. Quantum Physics – G Aruldhas

Semester – V
Condensed Matter Physics

Programme Name	B Sc in Physics	Semester	V
Course Title	Condensed Matter Physics		
Course Code	BSCPHCS502	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 h
Formative Assessment Marks	20	**Summative Assessment Marks**	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.

Course Pre - requisites: PUC Science Knowledge	**Programme Outcomes (Pos)**					
Course Outcomes (CO): After Successful completion of the course, the will be able to	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
1. Explain different distribution laws used in statistical Physics	**X**			**X**		**X**
2. Describe and compare various specific heat of solids and their limitations.	**X**	**X**		**X**		**X**
3. Understand the importance of new materials and their applications.	**X**		**X**			**X**
4. Explain X -ray spectra, crystal planes.	**X**	**X**	**X**	**X**	**X**	**X**
5. Describe the Superconducting phases of various materials with their experimental facts.	**X**	**X**			**X**	**X**
6. Explain the classification of solids on the basis of band theory of solids.	**X**	**X**		**X**	**X**	**X**
7. Demonstrate graphically electrical behaviors of various semiconductor devices.	**X**	**X**	**X**	**X**	**X**	**X**

Paper 2: Condensed Matter Physics		Duration
UNIT - I	**Statistical Physics:** Introduction, Micro & Macro states of a system, statistical (macroscopic) variables (P V T) or (P V N) or (E V N), Canonical ensembles & Comparison. Classical statistics (system) - M B distribution law, Quantum Statistics (system) - BE & FD distribution laws. Comparison between MB, BE & FD distribution laws. (3h) **Specific heat of Solids:** Introduction, definition for specific heat, atomic heat and phonon. Classical (Dulong - Petit's law) theory of specific heat of solids (qualitative). Einstein's theory of specific heat of solids (derivation & graph). Debye's theory of specific heat of solids (derivation & graph). Problems. (7h) **New materials: Nano materials -** Classification, production (sol - gel process), properties, applications. Piezo - electric and ferro electric materials, their electrical properties and applications. (3h)	13 h
UNIT - II	**X - Rays:** Production of X -ray using Coolidge tube, Origin of X - ray spectrum (continuous and characteristics), Duane - Hunt's law, Moseley's law, Bragg's law (derivation), Bragg's spectrometer.Problems. (3h) **X - ray crystallography:** Crystalline solids; single and polycrystalline solids, space lattice - basis - crystal structure, unit cell. Seven crystal system. Miller indices, planes of cubic crystal, interplanar spacing d_{hkl} for cubic system (derivation). Measuring lattice parameters (volume, effective number of atoms, coordination number, atomic packing fraction and density) of SC/ FCC system.Problems. (6h) **Superconductivity:** Superconductivity phenomenon, transition temperature $T_c . T_c$ for Hg, Pb, In, Cd materials. Properties of superconductors: Electrical resistance, persistent current, critical temperature, critical magnetic field, critical current density. Experiment facts of superconductivity; Meissner effect, Isotope effect, Josephson effect, BCS theory, Entropy, High temperature Superconductivity, Application of superconductors. Problems. (4h)	13 h
UNIT - III	**Band theory of solids:** Free electron theory of metals a glance (Mention the expressions for electrical conductivity of a metal, Fermi energy at T = 0 K & T > 0 K). Failure of free electron theory of metals. Band formation in solids with Li as example, meaning of filled energy band, valance band, conduction band, valance electron and conduction electrons. Classification of solids into insulator, semiconductor and conductors with E - B diagrams describing electrical conductivity. Intrinsic semiconductor: concept of hole formation, E_F level (derivation), electrical conductivity (derivation). Extrinsic semiconductors; n - type and p - type, their electrical conductivity expressions, P - N junction, forward and reverse bias of P - N junction with E - B diagrams and expressions for diode currents. Problems. (11h) **Hall effect:** Theory and experimental measurement of Hall coefficient. Problems. (2h)	13 h

UNIT - IV	**Semiconductor devices:** P - N diode: V-I characteristics & application. Zener diode: V-I characteristics & application. LED: Construction, mechanism & application. Tunnel diode characteristics & its application. BJT - input & output characteristics. J FET (n channel) - Transfer and drain characteristics. e -MOSFET - Transfer and drain characteristics. Comparison between BJT and FET. Thermistor. Solar cell - I-V characteristics and applications. Opto - electronic devices: LDR photo conductor, photo diode and photo transistor I-V characteristics and applications. Photo multiplier tube. Laser diode. SCR and UJT V-I characteristics and their applications. Problems. (13h)	13 h

References:

Text Books:

1. Solid State Physics - R K Puri and V K Babber., S Chand Publications, 1st Edition (2004).
2. Fundamentals of Solid-State Physics - B S Saxena, P N Saxena, Pragati prakashan Meerut (2017).
3. Introductory Nuclear Physics by Kenneth S Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclaer Physics, Irving Kaplan. NarosaPublishling House.
5. Semiconductor Devices Physics and Technology 2ndEdn – S M Sze
6. A text book of Engineering Physics - M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy - S Chand

Reference Books:

1. Introduction to solid state Physics, Charles Kittel, VII edition, (1996)
2. Solid State Physics - A J Dekker, MacMillan India Ltd, (2000)
3. Essential of Crystallography, M A Wahad, Narosa Publications (2009)
4. Solid State Physics - S O Pillai - New Age Int. Publishers (2001).

List of Experiments to be performed:

A minimum of 8 experiments are to be carried out.

Sl.No.	Name of the Experiment
1	Determination of energy gap of a semiconductor.
2	Determination of quantum efficiency of photodiode
3	Determination of fermi energy of copper.
4	Thermistor; determination of energy gap.
5	Specificchargeofanelectron
6	Hysteresis; study of magnetization of ferromagnetic material.
7	Rydberg constant using source Hydrogen lamp / Solar spectrum
8	Intensityofaspectralline using LDR photoconductor
9	Determination of Cauchy's constants using spectrometer

10	Diode characteristics (P – N diode, Zener diode and LED)
11	TransistorCharacteristics
12	Measurement of Hall coefficient of a semiconductor
13	Solar cell I-V characteristics
14	FET characteristics
15	Photo transistor characteristics
16	SCR characteristics
17	UJT characteristics
18	Absolute Capacity by using BG.
19	Study the attenuation of absorption of gamma rays in polymeric materials using Cs-137 source and G M counter.

Semester – VI
Nuclear Physics

Programme Name	B Sc in Physics	Semester	VI
Course Title	Nuclear Physics		
Course Code	BSCPHCS601	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 hours
Formative Assessment Marks	20	**Summative Assessment Marks**	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.

Course Outcomes (CO)	**Programme Outcomes (Pos)**					
After Successful completion of the course, the students will be able to	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
1. Describe the processes of alpha, beta and gamma decays based on well-established theories.	**X**	**X**	**X**	**X**	**X**	**X**
2. Explain nuclear forces, interaction of neutron with matter and induced radioactivity.	**X**	**X**	**X**	**X**	**X**	**X**
3. Knowledge of nuclear models, nuclear fission and fusion reactions and their applications in stellar energy.	**X**	**X**	**X**	**X**		**X**
4. Describe particle accelerators, detectors, cosmic rays and fundamental particles.	**X**		**X**	**X**	**X**	**X**

VI Semester

Paper 1: Nuclear Physics		Duration
Unit - I	**Nucleus, Radioactivity and Nuclear decay** Properties of nucleus: Nuclear constituents, nuclear size, mass, density, nuclear charge, binding energy curve, magnetic moment of nucleus. Rutherford alpha scattering formula assuming impact parameter - nuclear cross section - differential and total. Problems. (3h) Half-life, mean life, activity of radioactive nuclide. Successive disintegration, expression for number of daughter nuclei, radioactive equilibrium - transient and secular, radioactive series. (3h) Alpha decay, alpha particle disintegration energy, alpha ray spectra, range, velocity and energy relations. Geiger-Nuttal Law. Beta ray spectra and paradoxes, Pauli's neutrino hypothesis, modes of beta decay. Gamma ray emission, interaction of gamma rays with matter - photo electric effect (mention), Compton effect (mention) and pair production. (7h)	13 h
Unit - II	**Nuclear reactions and Nuclear force** Rutherford experiment, Q values of nuclear reactions, threshold energy for endoergic nuclear reaction, Types of nuclear reactions. Discovery, classification and properties of neutron. Neutron sources (mention), interaction of neutrons with bulk matter. Problems. (5h) Nuclear force - Characteristics of nuclear force. Yukawa's theory, estimation of mass of mesons using uncertainty principle. Mass spectrographs - Dempster's mass spectrograph. Problems. (6h) Induced radioactivity, applications of radio isotopes. Radiocarbon dating. (2h)	13h
Unit - III	**Nuclear models and Nuclear Energy** Nuclear models: Liquid drop model.Semi empirical mass formula, Shell model and magic numbers. Salient features of liquid drop model and shell model. (3h) Nuclear fission: Critical Mass, critical size. Nuclear power reactor. Four factor formula, application. (4h) Nuclear fusion: Thermonuclear reactions, principle of hydrogen bomb. Fusion reactor - Plasmaconfinement, Magnetic bottle. Sources of stellar energy - p-p Cycle & C-N cycle.Stellar Energy. Problems. (6h)	13 h
Unit - IV	**Particle Accelerators, Detectors, Cosmic rays and Fundamental Particles** Particle Accelerators: Linear accelerators, Cyclotron and Betatron, Microtron (principle only). Problems. (3h) Detectors: Gas filled counters - G M counter - construction and working, principle of scintillation and semiconductor detectors. Problems. (4h) Cosmic rays: Latitude and altitude effect, east west effect, primary and	13 h

	secondary cosmic rays and composition, origin of cosmic rays, cosmic ray showers, Van Allen Radiation belts, Aurorae. (3h) Fundamental particles: General properties - Dirac concept of anti-particles - classification based on interactions. Leptons and Hadrons. Quarks model and mediators of basic interactions. Problems. (3h)	

Books for Reference:

1. Concepts of Modern Physics, 6 Edn, Beiser
2. Modern Physics–Berstein, Fishbane, Gasirowiez
3. Modern Physics – K.S. Krane
4. Introductory Nuclear Physics – K.S.Krane
5. Introduction to Atomic and Nuclear Physics, 5^{th} Edn., Semat & Albright
6. Quantum Physics of Atoms, Molecules, Solids, Nuclei & Particles, 2nd Edn, Eisberg & Resnick
7. Nuclear Physics – Irving Kaplan
8. Modern Physics – Murugesan

Paper 2 - Electronics

Programme Name	B Sc in Physics	Semester	VI
Course Title	Electronics		
Course Code	BSCPHCS602	**No. of Credits**	03
Contact Hours	52	**Duration of SEA/ Exam**	03 h
Formative Assessment Marks	20	**Summative Assessment Marks**	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.

Course Pre - requisites:	**Programme Outcomes (Pos)**					
Course Outcomes (CO): After Successful completion of the course, the students will be able to	**PO- 1**	**PO- 2**	**PO- 3**	**PO- 4**	**PO- 5**	**PO- 6**
1. Describe and construct BJT and FET applications.	**X**	**X**	**X**	**X**	**X**	**X**
2. Explain various configurations of OPAMP and their applications.	**X**	**X**	**X**	**X**	**X**	**X**
3. Describe the working of Wein bridge oscillator satisfying Barkhausen criteria.	**X**	**X**	**X**	**X**	**X**	**X**
4. Explain individual components of regulated power supply and their modification.	**X**	**X**	**X**	**X**	**X**	**X**
5. Demonstrate different modes of communication electronics.	**X**			**X**		**X**
6. Understand and explain logical functions of basic logic gates and sequential circuits of digital electronics.	**X**	**X**	**X**	**X**	**X**	**X**

Paper 2: Electronics		Duration
Unit - I	**BJT Amplifiers:** Configurations of BJT. Current gains -Relation between α_{dc} and β_{dc}, Biasing of BJT in CE mode - Voltage divider bias. DC load - line and location of Q point. CE amplifier: DC and AC equivalent circuits, Amplifier characteristics, h - parameter model of transistor (CE mode), AC analysis of CE amplifiers, Frequency response (CE amplifier). Comparison between CE, CB and CC amplifiers. Cascading - Two stage CE amplifier (qualitative).Problems. (7h) **FET Amplifiers:** FET Biasing: Self bias of n channel JFET, DC load line - Q point ($I_{D_{min}}$, $I_{D_{max}}$, $I_{Ds_{min}}$, $I_{Ds_{max}}$) determination. Gate biasing of n - channel E - MOSFET - Draw bias line & Q point in transfer characteristics. Common source amplifier using n - channel JFET - AC analysis and frequency response. Problems. (6h)	13 h
Unit - II	**OPAMP and Oscillator** Operational amplifier (OPAMP): BJT deferential amplifier & its configurations - DC analysis of Dual input balanced output BJT differential amplifier. OPAMP: Symbol, equivalent circuit, characteristics of Ideal OPAMP. IC 741: Pin configuration, Characteristics, Frequency response. OPAMP configurations: Open loop, closed loop, OPAMP as inverting and non-inverting amplifiers (closed loop) - concept of virtual ground, expressions for voltage gainA_v,R_{in} , R_{out}. Application of OPAMP (any two): Adder, subtractor. Problems. (8h) Oscillator: Concept of feedback, positive and negative feedbacks, comparison - Expression for gain with feedback - condition for oscillation - Barkhausen criteria. Wein bridge oscillator - construction and working - advantages and disadvantages. Problems. (5h)	13 h
Unit - III	**Regulated Power Supply & Communication Electronics:** Regulated Power Supply (RPS): Block diagram of RPS, Full wave bridge rectifier - construction - working with waveforms - expression for ripple factor, efficiency - percentage of voltage regulation - Filters - explanation for C filter. Zener voltage regulator - line and load regulations - limitations - OPAMP voltage regulator (qualitative). 3 pin IC regulators: IC 78XX series, 79xx series, LM 317 as adjustable voltage and current regulators. Problems. (7h) Communication Electronics: Need for modulation. AM wave: Expression for AM wave - Expression for powers of carrier and side bands & total power - Band width. FM wave (qualitative), Demodulation using diode detector. Block diagram of satellite communication. Optical communication system (block diagram) - Expression for numerical aperture and attenuation coefficient of OFC (mention only). Mobile communication. Problems. (6h)	13 h
	Digital Electronics: Basics of computer (Block diagram) - Machine language - RAM - ROM - SSD. Number systems - conversion from binary to decimal, vice - versa. Problems. (2h) Logic gates: Basic logic gates - OR, AND, NOT gates construction using discrete components (symbol, truth table, operations, logical equations, logical decisions). EXOR gate - Symbol, truth table, logical	

Unit - IV	expression. NAND gate as universal gate (construct NOT, AND, OR & EXOR gates using NAND gates). Pin configurations of OR, AND, EXOR, NAND gates ICs. (4h) Boolean Algebra: Basic laws. De - Morgan's theorems - Proof using truth table. Solution and logical diagrams to Boolean expressions. Sum of product method - Simplification of SOP equations and drawing logical diagrams. Half adder and Full adders. Problems. (3h) Sequential circuits: Flip flops: R-S flip flop, clocked R-S flip flop (use NOR gate) - Explanation with truth table. J-K flip flop, D-flip flop (qualitative). Shift register: 4 bit serial shift register. Counters: 4 bit Ripple counter with timing diagram. Counter - BCD - 7 segment display (Block diagram), 7 segment display. Problems. (4h)	13 h

Reference:

1. Electronic Devices and circuits - 5thEd by David A Bell, Oxford Higher Education
2. A text book of Engineering Physics - M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy - S Chand
3. OP-AMPs and Linear integrated circuits 3rd Ed - Ramakanth A Gayakwad - EEE
4. Microelectronics - 2nd Ed - Jacob Millman Arvin Grabel - TATA Mc GRAW - Hill
5. Digital Fundamentals 10th Ed - Thomas L Floyd - Pearseon.
6. Semiconductor Devices Physics and Technology 2ndEdn – S M Sze

List of Experiments to be performed:

A minimum of 8 experiments are to be carried out in the laboratory.

Sl. No.	Name of the Experiments
1	Study the characteristics of Geiger-Mùller Tube. Determine thethreshold voltage, plateau region and operating voltage.
2.	Study the absorption of beta particles in aluminium foils using GM counter. Determine mass attenuation coefficient of aluminium foils.
3.	Study the absorption of beta particles in thin copper foils using G M counter and determine mass attenuation coefficient.
4.	Study the attenuation of gamma rays in lead foils using Cs-137 source and G M counter. Calculate mass attenuation coefficient of Lead for Gamma.
5	Full wave bridge rectifier
6	Zener voltage regulator
7	3 pin IC voltage regulator using LM 317
8	CE amplifier – Frequency response.
9	Amplitude modulation and demodulation
10	OP-amp inverting, non-inverting and difference amplifier

11	OPAMP adder and subtractors
12	Weinbridge oscillator
13	Measurement of attenuation coefficient & numerical aperture of OFC.
14	Stefanslaw verification
15	Construction of OR, AND, NOT, NAND & NOR gates using discrete components
16	BasicsLogicgates usingNAND gates.
17	BJT differential amplifier (two configurations)
18	Halfadder&fulladderusing ICs.
19.	Common source amplifier using JFET.

Distribution of marks SEP- 2024 for all the Semesters

I, II, III, IV, V and VI of B Sc (Physics theory exams) - Mangalore University

Internal Assessment : 20 (max. marks per paper). Average of two tests

Semester Examination: 80 (max. marks per paper)

Total : 100 (max. Marks per paper)

Question paper pattern

Reg No. | | | | | | | | | | |

---------- (Paper Code)

--------- Semester B.Sc. Examination, ---------- (Month) 2024

(SEP - 2024) (2024-2025 Batch Onwards)

PHYSICS (DSC)

(Title) ----------

Time: 03 Hours Max. Marks: 80

Instructions: i) Answer questions from **all** Parts.

ii) Scientific calculators are **allowed**.

Part A

I. Answer any **Eight** (answer 8 out of 10)questions **1×8 = 8**

II. Answer any **Six** (answer 6 out of 8) questions **2×6 = 12**

Part B

Answer One full question (1 out of 2) from each unit (I, II, III & IV)

Questions carrying 4 marks $1 \times 4 = 4$

Questions carrying 7 marks $1 \times 7 = 7$

(Total of each unit 4+7 =11)

(Total of four units **4× 11= 44**)

Part C

Problems. Answer any four (4 out of 6 at least 1 problem from each unit) **4 × 4 = 16**

Total of Part A, part B and Part C (8+12+44 +16 = 80) **= 80**

Distribution of marks in Practical exams:

Allotmentof marks	**I, II, III & IV Semester**	**V & VI Semester**
Formula	3	5
Circuit & diagram	3	5
Setting of the experiment	4	10
Observation& trails	10	20
Calculation&graph	3	15
Result&accuracy	3	5
Viva - Knowledgeoftheexperiment	4	10
Recordmarks	10	10
Total marks	**40**	**80**
Internal examination & continuous evaluation	10	20
Total Marks	**40+ 10 = 50**	**80 + 20 = 100**

Guidelines for subject with practicals regarding student-teachers ratio for conducting practicals under SEP-2024:

Practical batches: Every practical batch should have 15 students & one teacher. Under no circumstances there should be more than 20 students in a batch and more than 2 teachers in a batch.