Bangalore University
Department of Physics
Jnanabharathi Campus
Bengaluru – 560 056

Syllabus for

I & II Semester Physics Papers

Under-Graduate(UG) Program

Framed according to the State Education Policy (SEP 2024)

(Effective from Academic Year- 2024)

Board of Studies in Physics (UG)

Prof. M. K. Kokila	**Chairperson**	Department of Physics, Bangalore University,Bengaluru-56
Prof. B. Eraiah	**Member**	Department of Physics, Bangalore University,Bengaluru-56
Dr. K. Y. Madhavi	**Member**	Government First Grade College, Channapatna
Mr. T.N. Ashoka	**Member**	Government First Grade College Vijayanagara
Mr. B. G. Giridhar	**Member**	Government First Grade College Nelamangala
Dr. Shivaprakash. Y	**Member**	Government First Grade College, Magadi
Dr. Wajeeha Sultana	**Member (External)**	Maharani Cluster University Bengaluru -01
Dr. Sathish L. A.	**Member (External)**	Nrupathunga University, Bengaluru -01

Date: 01.07.2024
Bangalore-560056

Proceedings of the Board of Studies in Physics

Department: Physics
Board: UG
Proceeding of BOS (UG) Physics Meeting held on 1st July, 2024. In the Department of Physics BUB-56.
Time: 10.30am
The follwing Acenda was discussed 1. BSC.1st and 2nd semester SEP Syllabus of Physics papers 2. Panel of Examiners for UG for the acadmic year 2024-25 and BOE (Proposed) for the acadmic year 2024-25. After elaborate discussions and suitable modification the members of the BOS approved both the agenda.

Sl No.	Name of the BOS Member UG	Signature with date
01	Dr. M K Kokila (Chairperson) Professor, Department of Physics, BUB	1/7/24
02	Dr. B Eraiah Professor, Department of Physics, BUB	
03	Dr Madhavi K Y Govt. First Grade College, Channapatana-571501	
04	Dr Seeta Vasudev Rao. Asso.Professor Govt. First Grade College,Govt. High School, Building. Kengeri Statelite Town, Kengeri, Bangalore-60	Absent
05	Giridhar B G Associate Professor Govt. First Grade College, Govt. Junior College Annex, Nelmangala-562123, Bangalore Rural Dist.	
06	Ashoka T N Asst. Professor Govt. First Grade College, No.5, 3rd Main, 7th Cross, RPC Layout, Vijayanagar, Bangalore-560040	
07	Balakrishna, M T Associate Professor Rural College, Kanakapura Town, Ramanmagar District-562117	Absent
08	Dr Shivaprakash . Y Asso. Asst. Professor Govt. First Grade College Magadi-562120	
09	Dr Satish I. A. Professor Government Science College, Nrupathunga University, K. R. Circle, Bangalore-01	
10	Dr Wajeeha Sulthana Professor Maharani Cluster University, Bangalore-560 001.	
	Invitees	
11	Sri Ramesh T Govt. First Grade College, Fro Women, Bengaluru-01	

The course, B.Sc in Physics syllabus aims to enable students,

1. To understand and apply the principles of kinematics and dynamics.
2. To analyse frictional forces and their effects on motion.
3. To comprehend the concepts of work, energy, and power.
4. To explore the principles of rotational motion angular momentum and Moment of Inertia.
5. To study the properties of matter, including elasticity, viscosity and Surface tension.

Programe Outcomes (POs) By the end of the program, the student will be able to:		
PO1	Disciplinary Knowledge	Acquire and apply the subject knowledge of physics in solving day to day and their complexed real world problems.
PO2	Communication skills	Communicates effectively on physical activities with scientific community and with the society at large scale, and write effective reports on science events and design documentation, makes effective communication skills.
PO3	Critical thinking, Reflective thinking, Analytical reasoning, Scientific reasoning	Ability to think in unique manner unlike in conventional methods, giving scientific reasoning for all daily actions and generate solutions using critical thinking.
PO4	Problem solving	Acquire knowledge to solve any complex problems using simply methods
PO5	Research related skills	Use research based knowledge and research methods to provide valid and precise results.
PO6	Co-operation/Team work/Leadership qualities	Rendering co-operation and willing to work in team, leading the team with high expectations.
PO7	Information/Digital Literacy/Modern tool usage	Utilise the techniques and modern tools for solving complex problems with an understanding of limitations.
PO8	Environment and Sustainability	Understand the impact of environmental conditions on the development of subject and demonstrate the knowledge and need of the sustainable development
PO9	Multicultural competence	Applying the basics of physics in multicultural fields with excellent competence.
PO10	Multi disciplinary	Function effectively, as an individual, as a member or leader in divorce teams in Multi disciplinary fields.
PO11	Moral and ethical Awareness/Reasoning	Apply ethical principles and commit to professional ethics and responsibilities and norms of scientific practices.
PO12	Life long Learning/Self directed learning	Recognize the need for and have the preparations and ability to engage in independent and life long learning of physical studies.

1st & 2nd Semester
B.Sc.
Physics Syllabus

Model Curriculum

Program Name	B.Sc. in Physics	**Semester**	**I**
Course Title	Mechanics and Properties of Matter (Theory)		
Course Code	PHY UG T101	**No. of Credits**	**04**
Contact Hours	56 hours	**Duration of SEP/Exam**	3 hours
Formative Assessment Marks	20	**Summative Assessment marks**	80

Course pre-requisite(s):
COs- After the successful completion of the course, the student will be able to
CO1- Enrich the knowledge of vector algebra, Newton's law of motion and importance of friction
and forces in daily life
CO2- Facilitate the students to learn the importance of Gravitation and concepts of planetary motion,
needed to pursue higher education in Astrophysics.
CO3- Evaluate the concepts of rigid bodies, their moment of Inertia and different types of energies
needed to do work
CO4- Understand the behaviour of fluids and their viscous properties required to know their concepts
in different fields
CO5- Explore the different elastic materials and their material constants, and to know their
importance in day to day life

Contents	56 Hrs
UNIT 1 **Vector algebra:** Scalars and Vectors, vector algebra and operations, graphical and analytical methods, components of vectors, scalars and vector products.	**2 hours**
Newton's Laws of Motion (Statement and illustration), Motion in a resistive medium; concept of terminal velocity, Drag force and Drag Coefficient, Drag force with velocity [v] dependence (only (vertical) and v^2 dependence (only vertical) – derivation for velocity and position- graphs with and without resistance.	6 **hours**
Friction – Friction as a self-adjusting force, Coefficient of Static and dynamic friction; Expression for acceleration of a body moving along an inclined plane with and without friction, Free Body Diagrams for the following cases (i) Two masses connected by a string hanging over a frictionless pulley (ii) Two masses in contact and connected by string on a smooth horizontal surface (iii) Two masses connected by a string passing over a frictionless pulley fixed atthe edge on a horizontal plane.	**6 hours**

UNIT 2 **Gravitation and Planetary motion:** Law of Gravitation, Gravitational Field and Potential – relation between them, Field and Potential due to a solid sphere (derivation), Kepler's law (statements), Satellite motion, Orbital and Escape Velocity (derivation).	**7 hours**
Work and Energy: Work done by a constant and variable force; Work energy theorem; Work and potential energy; examples of potential energy; Work done by gravitational force; Work done by a spring force. Conservative and non – conservative forces, elastic and inelastic collisions. Concept of a system of particles, general expression for Centre of mass, Newton's law for a system of particles. Motion of rockets (qualitative).	**7 hours**

UNIT 3 **Dynamics of Rigid bodies:** Rotational motion about an axis, Relation between torque and angular momentum (derivation), Conservation of angular momentum with illustrations, Rotational energy (derivation).	**4 hours**
Moment of inertia (MI): Definition of MI and Radius of gyration, Laws of Moment of inertia, MI of a circular disc, sphere, rectangular lamina and Flywheel.	**4 hours**
Simple harmonic motion (SHM): Definition of simple harmonic motion, Differential equation of SHM and its solutions, different forms of the wave equation, expressions for amplitude, period, frequency of oscillations, Simple pendulum and compound pendulum; damped oscillations; forced oscillations, concept of resonance, coupled oscillations in phase and out of phase, energy transfer.	**6 hours**

UNIT 4 **Surface tension of fluids**: Molecular interpretation of surface tension; Surface energy (derivation); Angle of contact, Pressure difference across a curved surface - derivation in case of (a) spherical and (b) cylindrical surfaces. Interfacial tension (qualitative), factors affecting surface tension.	**4 hours**
Viscosity of fluids: Laminar flow, coefficient of viscosity, Poiseiulle's method of measuring viscosity, factors affecting viscosity, Stokes' law (derivation).	**5 hours**
Elasticity: Hooke's law, Stress – Strain diagram, definitions of three elastic moduli; Relationship between three elastic constants (derivation); Poisson's ratio; Theory of single cantilever, Torsional oscillations, Couple per unit twist (derivation).	**5 hours**

Course articulation matrix:- Mapping of course outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / **Program Outcomes (POs)**	**Program Outcomes (POs)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3		3		1					3	2
CO2			3		2		2			2		
CO3	1	2		2				2			3	3
CO4						2			3			
CO5		2		2			3			3		

Score indicators : High = 3, Medium = 2, Low = 1

Pedagogy: interactive lectures, inquiry-based learning, Blended leaarning, Learning based on Experiments

Formative Assessment Theory	
Assessment Occasion/Type	**Marks**
One Internal Test - C1	**10 marks**
Assignment/ seminar – C2	**05 marks**
Attendance – C2	**05 Marks**
Total	**20**
Formative Assessment as per University Guidelines are Compulsory	

Reference Books

1. Fundamentals of Physics- Resnick, D. Halliday and Walker; Wiley 12th Edition(2021).
2. Concepts of Physics Vol (1), H C Verma, Bharathi Bhavan Publishers, 2004 Edition.

3. Mechanics- Berkeley Physics Course Vol (1)- SI units Charles Kittel Walter D. Knight, and Malvin A. Ruderman McGraw-Hill Education (India) 2007 Edition.
4. The Feynman Lectures on Physics, Vol. 1: Mainly Mechanics, Radiation, and Heat" by Richard P. Feynman, Robert B. Leighton, and Matthew Sands (2011).
5. Mechanics- J C Upadhaya, Himalaya publishing House (2014 ed).
6. Elements of Properties of matter – D S Mathur, S.Chand and Co (2010).
7. Properties of Matter –Brijlal & Subramanyam, S. Chand & Co, (2002).
8. University Physics with Modern Physics by Hugh D. Young 15th Edition (2021).

Course Title	**Mechanics and Properties of Matter (PRACTICAL)**		**Practical Credits**	**02**
Course Code	**PHY UG-P102**		**Contact Hours /week**	**04**
Formative Assessment - Total 10 marks	**Attendance –C1**	**05 Marks**	**Summative Assessment**	**40**
	LabTest – C2	**05 Marks**		

SEP Syllabus for B.Sc. I Semester Physics
Paper -PHYUGP102: Mechanics and Properties of Matter

List of Experiments (A minimum of eight experiments to be performed)

1. Determination of coefficients of static, kinetic and rolling frictions.
2. Determination of **"g"** using bar pendulum.
3. Determination of **"g"** using simple pendulum and show that time period is independent of mass.
4. Study of motion of a spiral spring and to calculate spring constant and unknown mass.
5. Work done by a variable force using a spiral spring.
6. Verification of principle of conservation of energy.
7. Verification of parallel axis theorem using a bar-pendulum.
8. Verification of perpendicular axis theorem using torsional oscillations.
9. Determination of moment of inertia and mass of a Fly Wheel.
10. Determination of frequency of Coupled oscillator.
11. Verification of Hooke's law.
12. Determination of the Young's Modulus of the material of a bar by uniform bending method.
13. Determination of elastic constants of the material of a wire by Searle's double bar method.
14. Determination of rigidity modulus of the material of a wire - dynamic method.
15. Determination of rigidity modulus of the material of a rod – static torsion method.
16. Determination of the Young's Modulus of the material of a bar by single cantilever method.
17. Determination of surface tension of water and the interfacial tension between two immiscible liquids using drop weight method.
18. Determination of coefficient of viscosity of a liquid by Stoke's method.

References

1. B.Sc Practical Physics by C.L Arora
2. B.Sc Practical Physics by Harnam Singh and P.S. Hemne.

Model Curriculum

Program Name	B.Sc. in Physics		Semester	II
Course Title	Kinetic Theory of Gases, Heat and Thermodynamics			
Course Code	PHY UGT201		No. of Credits	04
Contact Hours	56 hours		Duration of SEP/Exam	3hours
Formative Assessment 20 Marks	Test-C1	10 marks	Summative Assessment marks	80
	Assignment/seminar-C2	05 marks		
	Attendance	05 marks		

Course pre-requisite(s):
COs- After the successful completion of the course, the student will be able to
CO1- Enrich the knowledge of Kinetic Theory of Gases, Transport phenomena in fluids and behaviour of real gases.
CO2- Facilitate the students to learn the importance of basic concepts of Thermodynamics, laws of Thermodynamics and entropy as measure of dis-orderness.
CO3- Evaluate the concepts of Thermodynamic Potentials, phase transitions of first order and applications of low temperature physics.
CO4- Understand the concepts of black body radiation, the various laws to explain the complete blackbody spectrum.
CO5- Explore the transmission of heat mechanism in solids and liquids.

Contents	56 Hrs
UNIT –I **Kinetic theory of gases:** Assumptions of Kinetic Theory of Gases, derivation of the pressure of a perfect gas, $PV = 1/3\ nmc^2$, Maxwell's law of distribution of velocities (qualitative), and deduction of most probable velocity, mean velocity and rms velocity. Expression for mean free path, degrees of freedom and principle of equipartition of energy. Specific heats of an ideal gas and atomicity of gases with derivation.	**6 hours**
Transport Phenomena: Viscosity and thermal conduction in gases (derivation). Relation between coefficient of viscosity and thermal conductivity of a gas.	**3 hours**

Real Gases: Derivation of Van der Waal's equation of state, Derivation of critical constants, Andrew's experiment on carbon dioxide, comparison of Van der Waal's isotherms with Andrew's isotherms.	**5 hours**

UNIT- II **Introduction to Thermodynamics:** Basic Concepts of Thermodynamics, Concept of system and Surroundings, Intensive and Extensive Properties, Microscopic and Macroscopic description of a system, Concept of mechanical, chemical and Thermal Equilibrium, Zeroth law of Thermodynamics and its significance, Concept of Heat and Temperature.	**4 hours**
First law of Thermodynamics: Sign Convention of Heat and Work, The first law of Thermodynamics, equation form of first law, and significance of first law. Equation of state PV^{γ} = Constant. Work done in an isothermal and adiabatic process for a perfect gas. Internal energy as a state function, Application of first law for cyclic, isothermal, adiabatic, isochoric, isobaric process**.**	**4 hours**
Second law of Thermodynamics: Reversible and Irreversible Process, Carnot engine, Carnot cycle and its efficiency (Derivation), Second law of Thermodynamics, (Kelvin's & Clausius Statements and their equivalence), Carnot Theorem (Proof), Refrigerator- Coefficient of Performance.	**4 hours**
Entropy: Basic concept of Entropy, Change in entropy in Reversible and Irreversible Process - Entropy and disorder, Relation between Entropy and second law, Clausius inequality, T-S diagram of a Carnot cycle.	**2 hours**

UNIT- III **Thermodynamic potentials:** Basic concepts of internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs free Energy and their importance, Derivation of Maxwell's Thermodynamic relations using Thermodynamic potentials, TdS Equations, Energy Equations and Heat Capacity equations.	**6 hours**
Low Temperature Physics: Joule Thomson experiment: Derivation of Joule Thomson Coefficient, Inversion Temperature. Adiabatic demagnetisation (Working and Theory)	**4 hours**
Phase Transitions of First Order: Melting, Freezing, Condensing, Vaporising, Deposition, Sublimation. Conditions of equilibrium of phases in terms of Gibbs potential, Clausius-Clapeyron equation, Elevation of boiling point and depression of freezing point, triple point	**4 hours**

UNIT - IV **Black Body Radiation:** Black body radiation and its Spectral energy distribution; Emissive power, Absorptive power, Emissivity, Kirchhoff's law, Stefan's law, Stefan-Boltzmann's law, Wien's displacement law, Wien's distributive law, Rayleigh- Jeans law (Statements), Derivation of Planck's law, Deduction of Wien's law and Rayleigh- Jeans law from Planck's Radiation law, Solar Constant, Estimation of Surface temperature of Sun**.**	**8 hours**
Transmission of heat in matter Conduction-Coefficient of Thermal Conductivity, Thermal conductivity of a good Conductor by Forbe's method, Thermal Conductivity of a poor conductor by Lee's disc method. Conduction along a bar, Conductivity of liquids and gases, Natural and forced Convection, Reynolds's number**.**	**6 hours**

Course articulation matrix: - Mapping of course outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) Program Outcomes (POs)	Program Outcomes (POs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3		2	2			2			1		2
CO2	3	3	1	3			2			2		1
CO3	2	1	3	3	2		2			2		2
CO4	4	2	2	1	3	1			3		1	2
CO5	3	3	2	2	2	1	2	1		1		

Score indicators : High = 3, Medium = 2, Low = 1

Pedagogy: interactive lectures, inquiry-based learning, blendedlearning, Learning based on Experiments.

Formative Assessment Theory	
Assessment Occasion/Type	**Marks**
One Internal Test-C1	**10**
Assignment/Seminar-C2	**05**
Attendance-C2	**05**
Total	**20**
Formative Assessment as per University Guidelines are Compulsory	

References Books:

1. Fundamental of Physics- R. Resnick & D. Halliday, Wiley 6thEdition 2001.
2. Heat and Thermodynamics- MM Zemansky, McGraw-Hill Education (India), 8th Edition 2011.

3. Heat and Thermodynamics- Brijlal and Subramanyam S Chand & Co, New Delhi 1985.
4. Heat and Thermodynamics- DS Mathur, S Chand & Co, New Delhi, 5th Edition 2004.
5. Thermal Physics- SC Garg, RM Bansal, CK Ghosh, McGraw-Hill education, 2nd Edition 2013.
6. Thermodynamics, Kinetic Theory of gases & Statistical Thermodynamics – F W Sears, G L Salinger, Narosa Publishing House, 3rd Edition, 1998.
7. Thermodynamics & Statistical Physics- Sharma & Sarkar, Himalaya Publishing House, 3rd edition, 1991.

Course Title	**Kinetic Theory of Gases, Heat and Thermodynamics (Practicals)**		**Practical Credits**	**02**
Course Code	**PHY UG-P202**		**Contact Hours /week**	**04**
Formative Assessment Total 10 marks	**Attendance-C1**	**05 marks**	**Summative Assessment**	**40**
	Lab test-C2	**05 marks**		

SEP Syllabus for B.Sc. II Semester in Physics

Paper -PHYUG P202: Kinetic Theory of Gases, Heat and Thermodynamics

List of Experiments (A minimum of eight experiments to be performed)

1. Determination of Specific heat capacity of liquid by Newton's law of cooling.
2. Verification of Newton's law of Cooling by the method of cooling.
3. Determination of Thermal Conductivity of Rubber by heating method.
4. Determination of Thermal Conductivity of bad conductor- Lee's &Charlton's method.
5. Determination of Thermal Conductivity of Copper- Searle's Method.
6. Verification of Stefan's law by electrical method.
7. Determination of Stefan's Constant by electrical method.
8. Verification of Clausius-Clapeyron Equation using Pressure Cooker.
9. Study of Gaussian distribution using Monte Carlo method.
10. Determination of Planck's constant using LED.
11. Thermal behaviour of a torch Filament-Determination of temperature of the filament of the bulb.
12. Calibration of Thermistor for temperature measurement.

References

1. B.Sc Practical Physics by C.L Arora
2. B.Sc Practical Physics by Harnam Singh and P.S. Hemne

Formative Assessment for Practicals	
Assessment Occasion/Type	**Marks**
One Internal Test	**05**
Attendance	**05**
Total	**10**
Fomative Assessment as per University Guidelines are Compulsory	

QUESTION PAPER PATTERN (INDICATIVE TEMPLATE)

I& II Semester B.Sc Examination, 2024-25
SEP – 2024 Onwards (1st Bactch)

Subject: Physics

Paper: PHY UGT101: Mechanics and Properties of Matter
&
Paper: PHY UGT201:Kinetic Theory of Gases, Heat and Thermodynamics

Time: 3hours **Max. Marks: 80**

Summative Assessment for Theory (For 80 Marks)

Part – A **(10X2=20)**

Question Number 1. [a] to [l] (12 Sub-Questions: a,b,c,d……l. Answer any 10 Sub-Questions)

Part – B **4X5=20** **(6 Questions: Answer any four)**

Question 2.
Question 3.
Question 4.
Question 5.
Question 6.
Question 7.

Part – C **4X10=40** **(6 Questions: Answer any four)**

Question 8.
Question 9.
Question 10.
Question 11
Question 12
Question 13

Summative Assessment for Practical (40 Marks)

1. Practical examination can have 30 marks
2. Viva-voce and practical record maintenance can have 10 marks.

1st& 2nd Semester B.Sc. Practical Examination

Distribution of Marks for the Practical Examination Paper:PHY UGP102 & PHY UGP202		
Sl No	**Particulars**	**Marks**
01	**Writing Principle/Statement/Formulae with symbols.**	**05**
02	**Drawing illustrative diagrams and expected graphs.**	**03**
03	**Setting up the experiment & taking readings**	**12**
04	**Calculations and graphs drawn based on experimental data.**	**05**
05	**Accuracy of results with units.**	**05**
06	**Valuation of Practical Record.**	**05**
07	**Viva voce**	**05**
	Total Marks	**40**