Sir P. T. Sarvajanik College of Science (Autonomous)
Athwalines, Surat-395001

SYLLABUS

for

Semester I

Program: B. Sc.

Course: Physics

Effective from

Academic Year

2025-26

Board of Studies in Physics

Undergraduate and PSOst graduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Prof. Sadanand Sutar	Chairperson	Sir P. T. Sarvajanik College of Science
All Faculty Members of the Department			
1	Prof. Vireshkumar Thakkar	Associate Professor	Sir P. T. Sarvajanik College of Science
2	Dr. Nisha Patel	Assistant Professor	Sir P. T. Sarvajanik College of Science
3	Dr. Dhiraj Shah	Assistant Professor	Sir P. T. Sarvajanik College of Science
4	Prof. Kileen Mahajan	Associate Professor	Sir P. T. Sarvajanik College of Science
5	Prof. Bhupesh Lad	Associate Professor	Sir P. T. Sarvajanik College of Science
6	Dr. Naveen Kumar Singh	Adhyapak Sahayak	Sir P. T. Sarvajanik College of Science
7	Dr. Jenishkumar Patel	Adhyapak Sahayak	Sir P. T. Sarvajanik College of Science
8	Prof. Pradipkumar Dholakia	Assistant Professor	Sir P. T. Sarvajanik College of Science
Subject Expert nominated by Vice-Chancellor			
1	Dr. Arvind Bajaj	Nominated Member	V. S. Patel College of Arts & Science, College Campus, Morarji Desai Marg, Bilimora
Subject experts			
1	Prof. Smita L. Survase	Nominated Member	K. J. Somaiya College of Commerce and Science (Autonomous), Mumbai
2	Prof. Mahesh Shetti	Nominated Member	Wilson College (Autonomous), Mumbai
Representative from Industry/corPSOrate sector/allied area			

1	Mr. Gopal Singh Panwar	Nominated Member	Officer, Human Resources, L & T Defence IC, Hazira, Surat
Meritorious Alumnus			
1	Mr. Darshankumar Jagdishbhai Gabani	Nominated Member	R & D Division, Lucan Techno, Katargam, Surat
Expert from other than the parent University			
1	Prof. Chetan Limbachia	Nominated Member	Head, Department of Applied Physics, M. S. University, Vadodara

Acknowledgement

At the outset, I would like to thank our, Principal Dr. Pruthul Desai for his guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Physics for the long and arduous work they have put in during the compiling of the restructured syllabus.

Prof. S. A. Sutar

(Chairperson, Board of Studies in Physics)

Graduate Attributes:

After the successful completion of modules in different courses of B. Sc. Physics, the learner will be able to:

GA 1: Apply Physics concepts and acquired skill sets to novel and unknown problems in order to establish an effective approach or strategy for dealing with them.

GA 2: Explore and derive quantitative data in the realms of Physics.

GA 3: Collect, analyse, and interpret scientific data in the realms of Physics using modern experimental apparatus and research methods.

GA 4: Develop Psycho-motive, analytical, observation skills through lab work

GA 5: Approach any real-life problem with proper assumption, logic and constraints.

GA 6: Prepare for jobs, career development, and lifelong learning in Physics, by using acquired ICT skills, Physics practical skills, and mathematical skills.

Programme Specific Outcomes:

PSO 1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PSO 2: Problem solving: Execute a solution process using the first principles of science to solve problems related to respective discipline.

PSO 3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in their discipline.

PSO 4: Ethics: Apply the professional ethics and norms in the respective discipline.

PSO 5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PSO 6: Communication: Communicate effectively with the stake holders and give and receive clear instructions.

Content

B. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics Paper – I

COURSE CODE: PHYMJ-S1P1-3CR24 [CREDITS – 03]

CC I	Course Code: PHYMJ-S1P1-3CR24

Course Learning Outcomes

At the end of this course, learners will be able to

- apply the concepts of vector algebra and vector calculus
- analyse different motions
- explain SHMs and their combinations
- analyse Lissajous figures
- classify various elastic properties of solids
- interpret various moduli of elasticity.

Unit I	Vector Analysis	[15L]

Learning Objective

This unit is intended to

- familiarize the students with the concepts of scalar product and vector product of two and three vectors
- make them learn vector differentiation and integration
- discuss gradient, divergence and curl of different point functions
- train them solve problems of Physics using products of vectors
- let them study the line, surface and volume integrals and associated theorems.

Learning Outcomes:

At the end of this unit, learners will be able to

- apply the concepts of scalar product and vector product of vectors in solving problems
- use differentiation, gradient, divergence and curl of the point functions in different cases
- interpret the line, surface and volume integrals and apply them to understand various theorems in vector calculus.

1.1	Review of dot or scalar product, Cross or vector product Triple product (2.4), reciprocal sets of vectors (2.5)	**[3L]**
1.2	Ordinary derivatives of vectors, space curves (3.2), continuity and differentiability, differentiation formulae (3.3), Partial derivatives of vectors (3.4), differential geometry (3.5). The vector differential operator del (4.1), the gradient (4.2), the divergence (4.3), the curl (4.4), formulae involving del (4.5), invariance (4.6).	**[6L]**
1.3	Ordinary integrals of vectors (5.2), line integrals (5.3), surface integrals (5.4), volume integrals (5.5). The divergence theorem of Gauss, Stokes' theorem, Green's theorem in the plane (statements only) (6.2).	**[6L]**

Text book:
Vector Analysis by Murray Spiegel, Schaum's Outline, 2nd Ed., McGraw-Hill, 2009.

Unit II	Combinations of SHMs	[15L]

Learning Objective:
This unit is intended to

- introduce different harmonic motions to the students
- make them analyse such motions and get the inferences
- train them to describe the combinations of SHMs and Lissajous figures.

Learning Outcomes:
At the end of this unit, learners will be able to

- understand various oscillatory motions
- determine the characteristics of various oscillatory motions
- apply superposition principle to find the resultant motion due to the combinations of two SHMs under different conditions
- analyse the Lissajous figures.

2.1	Introduction (1.1), linear harmonic oscillator (1.2), rotating phasors (1.3), determination of constants (1.4), energy of a linear harmonic oscillator (1.5), some harmonic oscillators (1.6), superposition of simple harmonic motions (1.7), Lissajous figures (1.8), uniform circular motion generated from two simple harmonic motions at right angles (1.9), superposition of two opposite circular motions (1.10).	**[15L]**

Text book:
A treatise on oscillations, waves and acoustics by D. Chattopadhyay, Books and Allied (P) Ltd., 1st Ed., 2016.

Unit III	Elasticity	[15L]

Learning Objective:
This unit is intended to

- familiarize the students about the property of elasticity and its types
- make them use Hooke's law and determine different elastic constants
- introduce to them the twisting couple and its use
- inform them about the different beams and their elasticity

Learning Outcomes:
At the end of this unit, learners will be able to

- compare the elastic properties of various materials
- develop quantitative problem-solving skills in all the topics covered
- apply theoretical knowledge to measure physical quantities by performing various practical in the laboratory.

3.1	Introduction (8.1), Load, stress and strain (8.2), Hooke's law (8.3), three types of elasticity (8.8), equivalence of a shear to a compression and an extension at right angles to each other (8.9), deformation of a cube – bulk modulus (8.12), modulus of rigidity (8.13), Young's modulus (8.14), relations connecting the elastic constant (8.15), Poisson's ratio (8.16), relations for K and η in terms of Poisson's ratio (8.17), limiting values of σ (8.18).	**[8L]**
3.2	Twisting couple on a cylinder (8.22), torsional pendulum (8.26), determination of coefficient of rigidity (n) for a wire (8.27), bending of a beam (8.29), the cantilever (8.30), transverse vibrations of a loaded cantilever (8.32), depression of a beam supported at the ends (8.33), determination of Y by bending of beams (8.34), Determination of elastic constants by Searle's method (8.36).	**[7L]**

Text book:

Properties of Matter by D. S. Mathur, 1st Ed., S. Chand and Co. 2016.

Reference Books:

1. Mathematical Methods in Physical Sciences by Mary L. Boas, 3rd Ed., Wiley publications, 2006.
2. Mechanics, Berkley Physics Course 1 by C. Kittle, W. D. Knight, M. Alvine and A. Ruderman, 2nd Ed., Tata McGraw-Hill, 1991.
3. University Physics by Sears and Zemansky, 15th Ed., Pearson publication, 2011.
4. University Physics by H. D. Young, R A Freedman and A Lewis Ford, 13th Ed. Pearson Education, 2013.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	30%	25%	5%	-	100%
II	20%	30%	25%	25%	-	-	100%
III	20%	30%	25%	25%	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• apply the concepts of vector algebra and vector calculus	√	√		√		
• analyse different motions	√	√		√		
• explain SHMs and their combinations	√	√		√		
• analyse Lissajous figures	√	√		√		
• classify various elastic properties of solids	√	√		√		
• interpret various moduli of elasticity	√	√		√		

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Physics Paper – II
COURSE CODE: PHYMJ-S1P2-3CR24 [CREDITS – 03]

CC II	Course Code: PHYMJ-S1P2-3CR24

Course Learning Outcomes

After the successful completion of the course, learners will be able to

- understand the basic concepts of geometrical optics, such as Fermat's principle and its applications
- understand the laws of reflection and refraction
- interpret different aberrations and their resolution
- extract the basic concepts of temperature, thermodynamics and entropy
- study particle properties of electromagnetic waves.

Unit I	Geometrical Optics	[15L]

Learning objectives:

This unit is intended to

- make the students familiarize with the behaviour of light rays and ray tracing techniques
- introduce to them the techniques of formation of images by mirrors and lenses
- apply them solving optical problems
- analyse optical phenomena, such as reflection, refraction, dispersion, aberrations, etc.
- make them understand how light behaves and how it can be manipulated using geometric optics principles.

Learning outcomes:

After the successful completion of the unit, learners will be able to

- understand optical elements and describe behaviour of light ray such as how light rays reflect, refract and disperse when interacting with optical elements
- calculate properties such as the position, size, orientation and nature of images formed (virtual or real) by optical systems
- gain skill to solving optical problems and understanding of optical instruments, such as different lenses, microscopes, telescopes and camera based on geometric optics.

1.1	Introduction (3.1), laws of reflection and refraction from Fermat's principle (3.2).	**[2L]**
1.2	Refraction at a single spherical surface (4.2), reflection by a single spherical surface (4.3), the thin lens (4.4), the principle foci and the focal length of a lens (4.5), the Newton's formula (4.6), lateral magnification (4.7), aplanatic points of a sphere (4.8), The Cartesian Oval (4.9),	**[10L]**

	Geometrical Proof for the Existence of Aplanatic points (4.10), The Sine Condition (4.11).	
1.3	Chromatic Aberration (6.2), Monochromatic Aberrations (6.3), Distortion (6.4).	**[3L]**

Text book:
Optics by Ajoy Ghatak, 6th Ed., McGraw Hill Edu. Pvt. Ltd., 2017.

Unit II	**Thermodynamics I**	**[15L]**

Learning objectives:
This unit is intended to

- provide an in-depth study of thermodynamics by covering its fundamental principles and concepts extensively.
- establish a solid foundation and equipping students with the necessary skills to apply thermodynamic principles effectively in various field of study.
- foster an intuitive grasp of thermodynamics by prioritizing the underlying Physics.

Learning outcome:
After the successful completion of the unit, learners will be able to

- explain the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium
- identify situations of thermal equilibrium and describe the factors influencing it
- define energy transfer through mass, heat and work for closed and control volume systems
- apply the first law of thermodynamics on closed and control volume systems
- recognize the distinction between reversible and irreversible processes and understand the concept of entropy production and its relation to irreversibility.

2.1	Temperature and thermal equilibrium (21.1), the ideal gas (21.5), a molecular view of pressure (22.2), the distribution of molecular speeds (22.4), distribution of molecular energies (22.5), equations of state for real gas (22.6).	**[7L]**
2.2	Heat: energy and transit (23.1), the transfer of heat (23.2), the first law of thermodynamics (23.8), the application of the first law of thermodynamics (23.8) Defining entropy change (24.2), entropy change for irreversible process (24.3).	**[8L]**

Text book:
Physics by Halliday, Resnik and Krane, Vol. 2, 5th Ed., Wiley. 2017.

Unit III	**Modern Physics I**	**[15L]**

Learning objectives:
This unit is intended to

- familiarize students with the particle properties of waves

- make them understand the three phenomena, viz, blackbody radiation, photoelectric effect and Compton effect, which eventually lead to the development of quantum mechanics
- make them learn production and properties of x-rays.

Learning outcome:

After the successful completion of the unit, learners will be able to

- understand the nature of electromagnetic waves and its properties
- analyse the properties of blackbody radiation and photoelectric effect and learn about the failure of wave theory of electromagnetic radiation to explain them
- apply x-ray diffraction techniques to determine some properties of solids
- correlate the properties of photons with those of the matter particles.

3.1	Electromagnetic waves (2.1), Blackbody radiation (2.2), photo-electric effect (2.3), what is light (2.4), X- rays (2.5), X-ray diffraction (2.6), Compton effect (2.7), pair production (2.8), photons and gravity (2.9).	**[15L]**

Text book:

Concepts of Modern Physics by A. Beiser, 6th Ed., McGraw Hill Edu. Pvt. Ltd. 2003.

Reference Books:

- University Physics by H. D. Young, R. A. Freedman and A. Lewis Ford, 13th Ed. Pearson Education, 2013.
- Fundamentals of Optics by F. Jenkins and H. White, 4th Ed., McGraw Hill Education, 2017.
- Heat and Thermodynamics by Mark W. Zemansky and Richard H. Dittman, 8th Ed., McGraw Hill Education, 2017.
- Modern Physics by Kenneth Krane, 4th Ed., Wiley, 2021.
- Modern Physics by Jeremy Bernstein, Paul Fishbane, Stephen Gasiorowicz, 1st Ed., Pearson, 2000.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	20%	30%	25%	25%	-	-	100%
II	20%	30%	25%	25%	-	-	100%
III	20%	30%	25%	25%	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• understand the basic concepts of geometrical optics, such as Fermat's principle and its applications	√	√		√		
• understand the laws of reflection and refraction	√	√		√		
• interpret different aberrations and their resolution	√	√		√		
• extract the basic concepts of temperature, thermodynamics and entropy	√	√		√		
• study particle properties of electromagnetic waves	√	√		√		

B. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics Practical – I

COURSE CODE: PHYMJ-S1PR1-1CR24 [CREDITS – 01]

Practical I	Course Code: PHYMJ-S1PR1-1CR24

Course Learning Outcomes

After the successful completion of the course, learners will be able to

- demonstrate practical skills
- correlate the Physics theory concepts through practical

1	Various measurements using Vernier calliper and screw gauge and to do error analysis
2	Various measurements using travelling microscope and cathetometer and to do error analysis
3	Understanding spectrometer and determination of angle of prism.
4	To plot the graph of various functions, such as linear, parabolic etc.
5	To determine force constant (k) of a spring.
6	To determine Poisson's ratio of rubber.
7	To determine "Y" by cantilever.
8	To determine "Y" by the method of bending.
9	To determine modulus of rigidity of a wire using torsional pendulum.
10	To study one-dimensional elastic collision using two hanging balls.

Reference Books:

- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- B. Sc. Practical Physics by C. L. Arora, S. Chand & Co., Reprint Ed., 2010
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- A Laboratory Manual of Physics for Undergraduate Classes by D. P. Khandelwal, 1st Ed., Vani Publication House, New Delhi, 1985.
- B. Sc. Practical Physics by Geeta Sanon, 1st Ed., R. Chand & Co., 2007.

Note:

- The duration of each experiment is of 2 hours. Two such experiments are to be performed by each student per week.
- In the external exam, a student will have to perform two experiments, one from each group. The experiment will be of 2-hour duration.
- There should be two examiners, one for each group, in the external examination.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
Practical I	25%	25%	20%	20%	5%	5%	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	

B. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics Practical – II

COURSE CODE: PHYMJ-S1PR2-1CR24 [CREDITS – 01]

Practical II	Course Code: PHYMJ-S1PR2-1CR24

Course Learning Outcomes

After the successful completion of the course, learners will be able to

- demonstrate practical skills
- correlate the Physics theory concepts through practical

1	To make students familiarize with appropriate use of various analog meters.
2	To compare the values of the passive components with their values obtained using colour code/printed values using DMM.
3	To study wattage of lamp.
4	To determine elastic constants Y and K by Searle's method.
5	To determine elastic constants η and K by Searle's method.
6	To determine resistivity of the material of a conductor using Ohm's law.
7	To determine the refractive index of the material of prism using spectrometer.
8	To determine focal length of a convex lens and a plano-convex lens using auto-correlation method.
9	To verify Newton's formula for a lens.
10	Study of liquid lens.

Reference Books:

- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- B. Sc. Practical Physics by C. L. Arora, S. Chand & Co., Reprint Ed., 2010
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- A Laboratory Manual of Physics for Undergraduate Classes by D. P. Khandelwal, 1st Ed., Vani Publication House, New Delhi, 1985.
- B. Sc. Practical Physics by Geeta Sanon, 1st Ed., R. Chand & Co., 2007.

Note:

➢ The duration of each experiment is of 2 hours. Two such experiments are to be performed by each student per week.

- In the external exam, a student will have to perform two experiments, one from each group. The experiment will be of 2-hour duration.
- There should be two examiners, one for each group, in the external examination.
- There should not be more than 10 students per examiner per session in the external examination.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
Practical II	25%	25%	20%	20%	5%	5%	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	

B. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics Paper – I

COURSE CODE: PHYMN-S1P1-2CR24 [CREDITS – 02]

EC I	COURSE CODE: PHYMN-S1P1-2CR24	
Course Learning Outcomes		
At the end of this course, learners will be able to • discover the difference between scalars and vectors • interpret the vector algebra • articulate the vector operator and its applications to various functions • extract the basics of Newtonian mechanics • classify the types of collisions and solve problems related to them.		
Unit I	**Vector Analysis**	**[15L]**
Learning Objective: This unit is intended to • familiarize the students with the concepts of scalar product and vector product of two and three vectors • make them learn vector differentiation and integration • discuss gradient, divergence and curl of different point functions • train them solve problems of Physics using products of vectors • study the line, surface and volume integrals and associated theorems.		
Learning Outcomes: At the end of this unit, learners will be able to • apply the concepts of scalar product and vector product of vectors in solving problems • use differentiation, gradient, divergence and curl of the point functions in different cases • interpret the line, surface and volume integrals and apply them to understand various theorems in vector calculus.		
1.1	Review of dot or scalar product and Cross or vector product. Triple product (2.4), reciprocal sets of vectors (2.5).	**[3L]**
1.2	Ordinary derivatives of vectors, space curves (3.2), continuity and differentiability, differentiation formulae (3.3), Partial derivatives of vectors (3.4), differential geometry (3.5). The vector differential operator del (4.1), the gradient (4.2), the divergence (4.3), the curl (4.4), formulae involving del (4.5), invariance (4.6).	**[6L]**
1.3	Ordinary integrals of vectors (5.2), line integrals (5.3), surface integrals (5.4), volume integrals (5.5). The divergence theorem of Gauss, Stokes' theorem, Green's theorem in the plane (statements only) (6.2).	**[6L]**
Text book:		

Vector Analysis by Murray Spiegel, Schaum's Outline, 2nd Ed. McGraw-Hill, 2009.

Unit II	Newtonian Mechanics	[15L]

Learning Objective:

This unit is intended to

- make the students familiarize with the Newton's laws of motion and their applications
- to make them analyse projectile motion
- to teach them to use basic laws of Physics while solving the problems of collisions.

Learning Outcomes:

At the end of this unit, learners will be able to

- discuss Newton's laws of motion and their applications
- describe the motion of a projectile in detail
- explain the collision problems and analyze them using the basic conservation laws.

2.1	Classical Mechanics (3.1), Newton's first law (3.2), Force (3.3), Mass (3.4), Newton's second law (3.5), Newton's third law (3.6), Weight and mass (3.7), Applications of Newton's laws in one dimension (3.8).	**[5L]**
2.2	Motion in three dimensions with constant acceleration (4.1), Newton's laws in three dimensional vector form (4.2), Projectile motion (4.3), Drag forces and the motion of projectile (4.4), Uniform circular motion (4.5), Relative motion (4.6).	**[5L]**
2.3	Collisions (6.1), Linear momentum (6.2), Impulse and momentum (6.3), conservation of momentum (6.4), Two-body collisions (6.5).	**[5L]**

Text book:

Physics by Halliday, Resnik and Krane, Vol. 1, 5th Ed., Wiley.

Reference Books:

1. Mathematical Methods in Physical Sciences by Mary L. Boas, 3rd Ed., Wiley publications.
2. Mechanics, Berkley Physics Course 1 by C. Kittle, W. D. Knight, M. Alvine and A. Ruderman, 2nd Ed., Tata McGraw-Hill, 1991.
3. University Physics by Sears and Zemansky, 15th Ed., Pearson publication, 2011.
4. University Physics by H. D. Young, R A Freedman and A Lewis Ford, 13th Ed. Pearson Education, 2013.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	30%	25%	5%	-	100%
II	20%	30%	25%	25%	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• discover the difference between scalars and vectors	√	√		√		
• interpret the vector algebra	√	√		√		
• articulate the vector operator and its applications to various functions	√	√		√		
• extract the basics of Newtonian mechanics	√	√		√		
• classify the types of collisions and solve problems related to them	√	√		√		

B. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics Practical – I

COURSE CODE: PHYMN-S1PR1-2CR24 [CREDITS – 02]

MN Practical I	Course Code: PHYMN-S1PR1-2CR24

Course Learning Outcomes

After the successful completion of the course, learners will be able to

- demonstrate practical skills
- correlate the Physics theory concepts through practical

1	Various measurements using Vernier calliper and screw gauge and to do error analysis
2	Various measurements using travelling microscope and cathetometer and to do error analysis
3	Understanding spectrometer and determination of angle of prism.
4	To plot the graph of various functions, such as linear, parabolic etc.
5	To study one-dimensional elastic collision using two hanging balls.
6	To study projectile motion.
7	To determine ‘g’ using free fall method.
8	To determine height of a ceiling using free fall method.
9	To verify law of conservation of linear momentum.
10	To verify law of conservation of kinetic energy during elastic collision.
11	To do data analysis using excel.
12	To do least square fitting of the given data.
13	To study exponential decay of random numbers.
14	To verify the perpendicular axes theorem of moment of inertia.
15	To verify the parallel axes theorem of moment of inertia.
16	To study simple pendulum.
17	To determine resistivity of the material of a conductor using Ohm’s law.
18	To study the probability distribution for two option system.
19	To study liquid lens.
20	To determine of focal length of lens using Gauss’ equation.

Reference Books:

- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- B. Sc. Practical Physics by C. L. Arora, S. Chand & Co., Reprint Ed., 2010
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- A Laboratory Manual of Physics for Undergraduate Classes by D. P. Khandelwal, 1st Ed., Vani Publication House, New Delhi, 1985.

- B. Sc. Practical Physics by Geeta Sanon, 1st Ed., R. Chand & Co., 2007.

Note:

- The duration of each experiment is of 2 hours. Two such experiments are to be performed by each student per week.
- In the external exam, a student will have to perform two experiments, one from each group. The experiment will be of 2-hour duration.
- There should be two examiners, one for each group, in the external examination.
- There should not be more than 10 students per examiner per session in the external examination.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
Practical I	25%	25%	20%	20%	5%	5%	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Basics of Physics – I
COURSE CODE: PHYMDC-S1P1-4CR25 [CREDITS – 04]

MDC I	COURSE CODE: PHYMDC-S1P1-4CR25	
	Course Learning Outcomes	
At the end of this course, students will be able to • differentiate between vectors and scalars • apply vector operations such as addition, subtraction, multiplication etc. • analyze motion in a plane • interpret the properties of fundamental forces of nature • apply Newton's laws of motion in solving problems • differentiate between conservative and non-conservative forces		
Unit I	**Physics and Mathematics**	**[15L]**
Learning objectives: This unit is intended to make the learners • aware of the basic concepts of Physics • understand the importance of Mathematics in Physics • study the branch of Physics, called Newtonian Mechanics		
Learning outcomes: At the end of this unit, learners will be able to • understand what is studied in Physics, the scope of Physics etc. • establish a linkage between Physics and Mathematics and understand the significance of Mathematics in the study of Physics • learn the difference between vectors and scalars • carry out vector operations such as addition, subtraction, multiplication etc.		
1.1	What is Physics (1.1), Physics and Mathematics (1.2).	**[03L]**
1.2	Vectors and scalars (2.1), equality of vectors (2.2), addition of vectors (2.3), multiplication of a vector by a number (2.4), subtraction of vectors (2.5), resolution of vectors (2.6), dot product of two vectors (2.7), cross product of two vectors (2.8).	**[12L]**
Unit II	**Motion and Kinematics**	**[15L]**
Learning objectives: This unit is intended to make the learners • study the motion and kinematics of motion		
Learning outcome: At the end of this unit, learners will be able to • study basics of kinematics • define properties associated with the motion of a particle moving on a straight line • analyze motion in a plane • characterize projectile motion		

2	Rest and motion (3.1), distance and displacement (3.2), average speed and instantaneous speed (3.3), average velocity and instantaneous velocity (3.4), average acceleration and instantaneous acceleration (3.5), motion in a straight line (3.6), motion in a plane (3.7), projectile motion (3.8).	**[15L]**
Unit III	**Force and Newton's Laws of Motion**	**[15L]**
Learning objectives: This unit is intended to make the learners • study the dynamics of motion • understand Newton's laws of motion and their applications		
Learning outcome: At the end of this unit, learners will be able to • learn the cause of motion, i.e., force • understand the properties of fundamental forces of nature • study Newton's laws of motion use them in solving problems		
3.1	Introduction (4.1), gravitational force (4.2), electromagnetic force (4.3), nuclear forces (4.4), weak forces (4.5).	**[05L]**
3.2	First law of motion (5.1), second law of motion (5.2), Newton's 3rd law of motion (5.4), pseudo forces (5.5), the horse and the cart (5.6), inertia (5.7).	**[10L]**
Unit IV	**Work and Energy**	**[15L]**
Learning objectives: This unit is intended to make the learners • study the basic concept of work • learn types of energy and forms of energy • understand how potential energy is associated with force		
Learning outcome: At the end of this unit, learners will be able to • study fundamentals of work, kinetic energy, potential energy and work energy theorem and its applications • understand the difference between conservative and non-conservative forces • know about the law of conservation of mechanical energy and its applications • learn the connection between potential energy and force • study different forms of energy		
4	Kinetic energy (8.1), work and work energy theorem (8.2), calculation of work done (8.3), work energy theorem for a system of particles (8.4), potential energy (8.5), conservative and non-conservative forces (8.6), definition of potential energy and conservation of mechanical energy (8.7), gravitational potential energy (8.9), potential energy of a compressed or extended spring (8.10), different forms of energy: mass energy equivalence (8.11).	**[15L]**
Text book: Concepts of Physics by H. C. Verma, Bharti Bhavan Publishers & Distributors, New Delhi, 2012		

Reference Books:

1) Physics by Halliday, Resnik and Krane, Vol. 1, 5th Ed., Wiley, 2017.
2) Sears & Zemansky's University Physics With Modern Physics by Hugh D. Young, Roger A. Freedman, A. Lewis Ford, Addison-Wesley, Student Edition, 2015

Online Learning Resources:

- https://ocw.mit.edu/courses/8-012-Physics-i-classical-mechanics-fall-2008/
- https://onlinecourses.nptel.ac.in/noc24_me148/preview

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	40%	40%	20%	-	-	-	100%
II	40%	40%	20%	-	-	-	100%
III	40%	40%	20%	-	-	-	100%
IV	40%	40%	20%	-	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• differentiate between vectors and scalars	√	√		√		
• apply vector operations such as addition, subtraction, multiplication etc.	√	√		√		
• analyze motion in a plane	√	√		√		
• interpret the properties of fundamental forces of nature	√	√		√		
• apply Newton's laws of motion in solving problems	√	√		√		
• differentiate between conservative and non-conservative forces	√	√		√		

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Bio-Physics – I
COURSE CODE: PHYMDC-S1P2-4CR25 [CREDITS – 04]

MDC II	COURSE CODE: PHYMDC-S1P2-4CR25	
	Course Learning Outcomes	
At the end of this course, students will be able to • interpret the concept of systems and mathematical expressions • interpret the concepts of static forces • apply the concepts of static forces for various parts of human body • relate the heat transfer kinetics • apply the heat transfer kinetics for biological systems • extract the knowledge of the laws of thermodynamics • apply the laws of thermodynamics to the living systems		
Unit I	**The Systems Concept and Ten Useful Pillars of Mathematical Expression**	**[15L]**
Learning objectives: This unit is intended to make the learners • familiarize with the mathematical tools		
Learning outcomes: At the end of this unit, learners will be able to • understand the concept of systems and mathematical expressions		
1	**Chapter 1:** Systems concept, ten pillars: the variable (1), function (2), limits (3), increments (4), instantaneous rate of change – experimental, graphical, analytical (5), differential and integral calculus (6), distributions of observations (7), expression of deviations (8), indices and logarithms (9), infinite series (10), problems.	**[15L]**
Text book: Biophysics: Concepts and Mechanisms by E.J. Casey, East-West Press Pvt. Ltd (1969)		
Unit II	**Static Forces**	**[15L]**
Learning objectives: This unit is intended to make the learners • study equilibrium considerations for human body under the action of static forces		
Learning outcome: At the end of this unit, learners will be able to • apply the concepts of static forces for various parts of human body		
2	Equilibrium and stability (1.1), equilibrium considerations for the human body (1.2), stability of the human body under the action of an external force (1.3), skeletal muscles (1.4), levers (1.5), the elbow (1.6), the hip (1.7), limping (1.7.1), the back (1.8), standing tip-toe on one-foot (1.9), dynamic aspects of posture (1.10), problems.	**[15L]**

Text book:
Physics in Biology and Medicine by Paul Davidovits, Academic Press (2008)

Unit III	Heat and Kinetic Theory	[15L]

Learning objectives:
This unit is intended to make the learners

- study the concepts of heat and its different transfer mechanisms in the context of biological systems

Learning outcome:
At the end of this unit, the learners will be able to

- understand and apply the heat transfer kinetics for biological systems

3	Heat and hotness (9.1), kinetic theory of matter (9.2), unit of heat (9.3.1), specific heat (9.3.2), latent heats (9.3.3), transfer of heat (9.4), conduction (9.4.1), convection (9.4.2), radiation (9.4.3), diffusion (9.4.4), transport of molecules by diffusion (9.5), diffusion through membranes (9.6), the respiratory system (9.7), surfactants and breathing (9.8), diffusion and contact lenses (9.9), problems.	**[15L]**

Text book:
Physics in Biology and Medicine by Paul Davidovits, Academic Press (2008)

Unit IV	Thermodynamics	[15L]

Learning objectives:
This unit is intended to make the learners

- study the concepts of laws of thermodynamics and its associations with the living systems

Learning outcome:
At the end of this unit, learners will be able to

- interpret the laws of thermodynamics and connect it with the living systems

4	First law of thermodynamics (10.1), second law of thermodynamics (10.2), difference between heat and other forms of energy (10.3), thermodynamics of living systems (10.4), information and the second law (10.5), problems.	**[15L]**

Text book:
Physics in Biology and Medicine by Paul Davidovits, Academic Press (2008)

Reference Books:

1) Biophysics: A Student's Guide to the Physics of the Life Sciences and Medicine by William C. Parke, Springer, (2020)
2) Biophysics by Vasantha Pattabhi and N. Gautham Kluwer Academic Publishers (2002)

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc20_ph02/preview
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/243

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	40%	40%	20%	-	-	-	100%
II	30%	40%	30%	-	-	-	100%
III	30%	40%	30%	-	-	-	100%
IV	30%	40%	30%	-	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• interpret the concept of systems and mathematical expressions	√	√			√	√
• interpret the concepts of static forces	√	√				√
• apply the concepts of static forces for various parts of human body	√	√	√		√	
• relate the heat transfer kinetics	√	√				√
• apply the heat transfer kinetics for biological systems	√	√			√	√
• extract the knowledge of the laws of thermodynamics	√	√				√
• apply the laws of thermodynamics to the living systems	√	√	√		√	

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Space Science – I
COURSE CODE: PHYMDC-S1P3-4CR25 [CREDITS – 04]

MDC III	COURSE CODE: PHYMDC-S1P3-4CR25
	Course Learning Outcomes

At the end of this course, students will be able to

- interpret the celestial objects and astronomical instruments
- explain the principle of astronomical instruments in the observation of celestial phenomena and objects
- use Stellarium and Skyview software
- extract the physical properties of planets of our solar system
- classify different layers of the Sun and explain different naturally occurring phenomena such as sunspots, solar flares and prominences in the Sun
- elaborate the formation of different kinds of star and their process of evolution and classify the stars with the help of H-R diagram
- explain the stability of the star due to the mechanical pressure and gravitational pull and relate formation of different stars such as white dwarf, red-giant, neutron star and black hole
- describe the structure of galaxy and interpret the rate of expansion of the universe at large scale and estimate age and size of Universe.

Unit I	Astronomical Instruments and Celestial Objects	[15L]

Learning objectives:

This unit is intended to make the learners

- familiarize with the celestial objects and astronomical units
- familiarize with the kinds of telescopes
- study different parameters of telescope
- explore the universe by combining modern technologies with the application of modern Physics
- explore Stellarium and Skyview softwares.

Learning outcomes:

At the end of this unit, learners will be able to

- identify different celestial objects
- use the astronomical instruments to observe the celestial phenomena or objects
- design and use basic telescopes
- convert units in astronomical units.

1	**Brief Introduction of Celestial Objects:** Planets, Natural Satellites, Asteroids, Meteors, Comets, Nebula, Black holes, White dwarfs, Red Giant, Super Giant, Neutron Stars, Binary Stars, Galaxies. **Telescopes:** Optical telescope, Radio telescope and Hubble Telescope. **Software:** Stellarium and SkyView softwares.	[15L]

	Units: Units used in Astronomy such as parsec, AU, light year etc.	

Text book:

- Schaum's Outline of Astronomy: Stacy E. Palen, McGraw-Hill Publishing Company Limited, 2020.

Unit II	**Our solar system**	**[15L]**

Learning objectives:

This unit is intended to make the learners

- study the physical properties of planets
- study the orbital motion of planets of our solar system
- understand the rotational motion of planets and explain the magnetic field of planets
- study the crust, mantle and core of the Earth and study its motion and its magnetic field
- describe the different layers of the Sun
- explain different phenomena occurring at the surface of the Sun such as sunspots, solar flares, prominences etc.

Learning outcome:

At the end of this unit, learners will be able to

- estimate the physical properties of planets such as temperature, albedo, solar day etc.
- understand curst, core of the Earth and its magnetic field
- understand the core of the Sun and differentiate its different layers
- explain different phenomena and nuclear fusion reaction in the Sun.

2.1	**Planets:** Interior planets, Exterior planets; crust, mantle and core of the Earth; Different region of earth's atmosphere; Rotation of Earth, Magnetosphere; Van Allen Belts- Aurora.	**[10L]**
2.2	**The Sun:** Structure of Photosphere, Chromosphere, Corona, Sunspots, Solar Flares, Solar Prominences, Solar Plages.	**[5L]**

Text book:

- Schaum's Outline of Astronomy: Stacy E. Palen, McGraw-Hill Publishing Company Limited, 2020.

Unit III	**Evolution of Star**	**[15L]**

Learning objectives:

This unit is intended to make the learners

- understand the formation of different kinds of stars and their process of evolution
- familiarise with the formation of different celestial objects depending upon their mass
- classify the stars with the help of H-R diagram
- understand the stability of the star due to the mechanical pressure and gravitational pull
- differentiate formation of different stars such as white dwarf, red-giant, neutron star, black hole etc.

Learning outcomes:

At the end of this unit, learners will be able to

- interpret the Steller evolution
- relate the stability of star with the mechanical pressure and gravitational pull

• identify different stars with help of H-R diagram.		
3.1	**Stellar Evolution:** Why do stars evolve? How do stars evolve?, Stars < (less than) 8 Solar mass, Stars > (greater than) 8 Solar Mass, Supernovae, Where do we come from?, Hertzsprung–Russell diagram, Main sequence stars.	**[10L]**
3.2	**Stellar Remnants:** Degenerate Gas Pressure, White dwarfs, Neutron Stars, Chandrashekhar's Limit, Schwarzschild radius and Black holes.	**[5L]**
Unit IV	**Cosmology**	**[15L]**

Learning objectives:

This unit is intended to make the learners

- understand the structure of Galaxy
- understand the rate of expansion of the universe at large scale
- learn the Hubble's Law.

Learning outcome:

At the end of this unit, learners will be able to

- interpret the formation of Galaxy
- explain the expansion of the universe
- estimate the age and size of the universe.

4.1	**Galaxies and Clusters:** The Milky Way, Normal Galaxies, Active Galaxies and Quasars.	**[5L]**
4.2	**Cosmology:** Hubble's Law, Hubble's Law and expansion of the universe, Hubble's Law and age of the universe, Hubble's Law and size of the universe, The Big bang, Life in the universe.	**[10L]**

Text book:

- Schaum's Outline of Astronomy: Stacy E. Palen, McGraw-Hill Publishing Company Limited, 2020

Reference Books:

- An Introduction to Astrophysics: Baidyanath Basu, Tanuka Chattopadhyay and Sudhindra Nath Biswas, 2nd Ed., Prentice Hall India Learning Private Limited 2010.
- An Introduction to Astronomy and Astrophysics: Pankaj Jain, 1st Ed., CRC Press Publishing Company 2015.

Online Learning Resources:

- https://onlinecourses.swayam2.ac.in/arp19_ap73/preview
- https://www.classcentral.com/course/swayam-overview-of-space-science-293424
- https://ocw.mit.edu/courses/8-282j-introduction-to-astronomy-spring-2006/

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	40%	40%	20%	-	-	-	100%
II	40%	40%	20%	-	-	-	100%
III	40%	40%	20%	-	-	-	100%
IV	40%	40%	20%	-	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• interpret the celestial objects and astronomical instruments	√	√	√			√
• explain the principle of astronomical instruments in the observation of celestial phenomena and objects	√	√			√	√
• use Stellarium and Skyview softwares	√	√	√			√
• extract the physical properties of planets of our solar system	√	√				
• classify different layers of the Sun and explain different naturally occurring phenomena such as sunspots, solar flares and prominences in the Sun	√	√			√	
• elaborate the formation of different kinds of star and their process of evolution and classify the stars with the help of H-R diagram	√	√	√			√
• explain the stability of the star due to the mechanical pressure and gravitational pull and relate formation of different stars such as white dwarf, red-giant, neutron star and black hole	√	√			√	
• describe the structure of galaxy and interpret the rate of expansion of the universe at large scale and estimate age and size of Universe	√	√				√

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Programming in "C" Language – I
COURSE CODE: PHYSEC-S1P1-2CR25 [CREDITS – 02]

SEC I	Course Code: PHYSEC-S1P1-2CR24
	Course Learning Outcomes

After the successful completion of the course, learners will be able to:

- demonstrate practical skills
- utilize Physics theory concepts through practical

To formulate algorithm, flow chart and program for the following:		[60L]
1	Average of a set of numbers	
2	Area of a triangle	
3	Sorting a set of numbers in ascending and descending order	
4	Summing the series of numbers	
5	To find largest/smallest of three integers	
6	Convert temperature in Celsius to Fahrenheit and Kelvin.	
7	Write a C program to display "This is my first C Program"	
8	Write a C program to perform addition, subtraction, division and multiplication of two numbers.	
9	Write a Program to calculate and display the volume of a CUBE having its height (h=10cm), width (w=12cm) and depth (8cm).	
10	Write C program to evaluate each of the following equations. 1. $V = u + at$ 2. $S = ut + \frac{1}{2}at^2$ 3. $T = 2 * a + \sqrt{b + 9 * c}$ $H = \sqrt{b^2} + a^2$	
11	Write a program to calculate simple and compound interest.	
12	Write a program to swap values of two variables with and without using the third variable.	
13	Write a program to input the name, marks of 5 subjects of a student and display the name of the student, the total marks scored, percentage scored and the class of result.	

Reference Books:

- Computer Programming in C by V. Rajaraman, 2nd Ed., PHI Learning Pvt. Ltd., 1994.

Online Learning Resources:

- https://ocw.mit.edu/courses/6-087-practical-programming-in-c-january-iap-2010/
- https://www.coursera.org/specializations/c-programming
- https://www.learn-c.org/

Note:

- The duration of each experiment is of 2 hours. One experiment is to be performed byeach student per week.
- In the external exam, a student will have to perform one experiment. The experimentwill be of 2-hour duration.
- The batch for external examination shall have maximum 20 students.
- There should be two examiners in the external examination.
- There should not be more than 10 students per examiner per session in the externalexamination.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√		√	√
• utilize Physics theory concepts through practical	√	√			√	

B. Sc. (Physics) SEMESTER I
COURSE TITLE: Electrical Circuits and Network Skills
COURSE CODE: PHYSEC-S1P2-2CR25 [CREDITS – 02]

SEC – II	COURSE CODE: PHYSEC-S1P2-2CR25	
	Course Learning Outcomes	
At the end of this course, students will be able to • understand passive and active components and their testing • use different electronic equipment • apply practical skills necessary for real-world applications.		
	Electrical Circuits and Network Skills (Practical)	**[60L]**
Learning objectives: This unit is intended to make the learners • ensure that students gain both theoretical knowledge and practical skills in electrical circuits and networks.		
Learning outcomes: At the end of this unit, learners will be able to • know the passive and active components in electronics • know and use equipment of electronics like power supply, multi-meters etc.		
1.	To identify different electrical components: resistor, capacitor, variable resistor, rheostat, dc voltage sources: battery, battery eliminator, power supply etc.	
2.	To use ammeter and voltmeter in a circuit and measure current and voltage.	
3.	To use a multi-meter for measuring (a) resistances, (b) AC and DC voltages, (c) DC current and checking electrical continuity.	
4.	To connect resistances in series and parallel and measure the equivalent resistance using multi-meter.	
5.	To build a dc circuit using elements like battery, resistances and switch and measure current flow and voltage drop across the components.	
6.	To identify the electronic components like rectifying diodes, Zener diodes, transistors, carbon resistances, capacitors and test them with a multi-meter.	
7.	To determine the resistivity of a conductor using Ohm's law.	
8.	To study wattage of lamp.	
9.	To study the Kirchhoff's current law.	
10.	To study the Kirchhoff's voltage law.	
11.	To study Voltage Division Rule. (VDR)	
12.	To study Current Division Rule. CDR)	
13.	To determine Plank's constant (h) using LEDs of different colours.	
14.	To determine Boltzmann constant using transistor SL100.	

15.	To study superposition theorem.	
16.	To study PN junction diode (forward bias and reverse bias characteristics)	
17.	4-Minor Projects	

Reference Books:

- A textbook in Electrical Technology – B L Theraja – S Chand & Co.
- A textbook of Electrical Technology – A K Theraja
- Performance and design of AC machines – M G Say ELBS Ed.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_ee81/preview
- https://onlinecourses.nptel.ac.in/noc22_ee93/preview

Note:

- The duration of each experiment is of 2 hours. One experiment is to be performed by each student per week.
- In the external exam, a student will have to perform one experiment. The experiment will be of 2-hour duration.
- The batch for external examination shall have maximum 20 students.
- There should be two examiners in the external examination.
- There should not be more than 10 students per examiner per session in the external examination.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
• understand passive and active components and their testing	√	√	√		√	√
• use different electronic equipments	√	√	√		√	
• apply practical skills necessary for real-world applications	√	√	√		√	√