SYLLABUS

for

Semester III and IV

Program: B. Sc.

Course: Physics

Effective from

Academic Year

2025-26

Board of Studies in Physics
Undergraduate and Post 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. Bhupesh Lad	Associate Professor	Sir P. T. Sarvajanik College of Science
5	Dr. Naveen Kumar Singh	Adhyapak Sahayak	Sir P. T. Sarvajanik College of Science
6	Dr. Jenishkumar Patel	Adhyapak Sahayak	Sir P. T. Sarvajanik College of Science
7	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	Sant Rawool Maharaj Mahavidyalay, Tal-Kudal, Dist.-Sindhudurg, Maharashtra
2	Prof. Mahesh Shetti	Nominated Member	Wilson College (Autonomous), Mumbai
3	Dr. Debesh R. Roy	Nominated Member	Sardar Vallabhbhai National Institute of Technology, Surat
Representative from Industry/corporate 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:

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

PO 2: Problem solving: Execute a solution process using the 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 their discipline.

PO 4: Ethics: Apply the professional ethics and norms in the 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.

Sr. No	Course number	Course Code	Course title
		Semester III	
1	CC V	PHYMJ-S3P5-2CR25	Optics
2	CC VI	PHYMJ-S3P6-2CR25	Electronics
3	CC VII	PHYMJ-S3P7-4CR25	Mathematical Methods and Quantum Mechanics
4	CC PRACTICAL V	PHYMJ-S3PR5-2CR25	Physics Practical – V
5	CC PRACTICAL VI	PHYMJ-S3PR6-2CR25	Physics Practical – VI
6	MDC IV	PHYMDC-S3P4-4CR25	Numerical Analysis
7	MDC V	PHYMDC-S3P5-4CR25	Biomedical Instrumentation
8	MDC VI	PHYMDC-S3P6-4CR25	Plasma Science
9	MDC VII	PHYMDC-S3P7-4CR25	Applications of Differential Equations
10	SEC IV	PHYSEC-S3P4-2CR25	Programming in "C" Language – III
11	SEC V	PHYSEC-S3P5-2CR25	Basic Electronic Circuits and Designing – I
12	SEC VI	PHYSEC-S3P6-2CR25	Instrumentation Laboratory Skills – I
		Semester IV	
1	CC VIII	PHYMJ-S4P8-2CR25	Electromagnetism
2	CC IX	PHYMJ-S4P9-2CR25	Thermodynamics
3	CC X	PHYMJ-S4P10-4CR25	Mechanics, Crystallography and Optoelectronics
4	CC PRACTICAL VII	PHYMJ-S4PR7-2CR25	Physics Practical – VII
5	CC PRACTICAL VIII	PHYMJ-S4PR8-2CR25	Physics Practical – VIII
6	MN III	PHYMN-S4P3-2CR25	Rotational and Oscillatory Motions
7	MN PRACTICAL III	PHYMN-S4PR3-2CR24	Physics Practical – III
8	SEC VII	PHYSEC-S4P7-2CR25	Programming in "C" Language – IV
9	SEC VIII	PHYSEC-S4P8-2CR25	Basic Electronic Circuits and Designing – II
10	SEC IX	PHYSEC-S4P9-2CR25	Instrumentation Laboratory Skills – II

Semester III

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Optics
COURSE CODE: PHYMJ-S3P5-2CR25 [CREDITS - 02]

CC V	Course Code: PHYMJ-S3P5-2CR25		
	Course Learning Outcomes		
At the end of this course, learners will be able to - interpret diffraction and polarization of light and use diffraction grating to determine wavelength of light - classify resolving power of various optical instruments - identify various methods of polarizing an unpolarised light and use optical activity and apply it to solve problems - recall the phenomena such as reflection, refraction and total internal reflection and extract the structure of optical fiber, their properties, its significance in context to communication - identify the importance of glass fibers and examine attenuations and their effect while using optical fibers in communication - relate multimode fibers and their significance in communication and inspect power law profile of various optical fibers.			
Unit I	**Diffraction and Polarization**		**[15L]**
Learning Objectives: This unit is intended to make the learners - familiarize with the concepts of diffraction of light, diffraction grating and polarization of light - understand the resolving power of optical instruments - study optical activity and its applications			
Learning Outcomes: At the end of this unit, learners will be able to - interpret diffraction and polarization of light and use diffraction grating to determine wavelength of light - classify resolving power of various optical instruments - identify various methods of polarizing an unpolarised light and use optical activity and apply it to solve problems			
1.1	**Diffraction:** Introduction (18.1), Single-slit Diffraction Pattern (18.2), Diffraction by a Circular Aperture (18.3), Limit of Resolution (18.5), Two-slit Fraunhofer Diffraction Pattern (18.6), N-slit Fraunhofer Diffraction Pattern (18.7), The Diffraction Grating (18.8), Oblique Incidence (18.9), Fresnel Half-Period zones (20.2), The Zone-Plate (20.3), Diffraction At A Straight Edge (20.6).	**[10L]**	
1.2	**Polarization:** Introduction (22.1), Malus' Law (22.2), Production of Polarized Light (22.3), Analysis of Polarized Light (22.7), Optical Activity (22.8).	**[5L]**	

Text book:

Optics by Ajoy Ghatak, McGraw Hill Education (India) Private Limited, 6th Ed., 2017

Unit II	Fiber Optics	[15L]

Learning Objectives:

This unit is intended to make the learners

- revise the concept of total internal reflection and its importance in the functioning of optical fiber in the field of communication
- learn about the properties of optical fibers
- study the attenuation and losses in optical fibers
- understand multimode fibers and their significance in communication
- learn difference between coherent and incoherent bundles and their applications
- learn fiber optic sensors.

Learning Outcomes:

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

- recall the phenomena such as reflection, refraction and total internal reflection and extract the structure of optical fiber, their properties, its significance in context to communication
- identify the importance of glass fibers and examine attenuations and their effect while using optical fibers in communication
- relate multimode fibers and their significance in communication and inspect power law profile of various optical fibers.

2.1	Introduction (28.1), Total Internal Reflection (28.3), The Optical Fiber (28.4), Large Diameter Plastic Fibers (28.4.1), Why Glass Fibers? (28.5), The Coherent Bundle (28.6), The Numerical Aperture (28.7), Attenuation in Optical Fibers (28.8), The Attenuation Limit (28.8.1), Multimode Fibers (28.9), Power Law Profile (28.9.1), Plastic Optical Fibers (28.13), Fiber Optic Sensors (28.14).	[15L]

Text book:

Optics by Ajoy Ghatak, McGraw Hill Edu. (India) Pvt. Ltd., 6th Ed., 2017

Reference Books:

- ➢ Principles of Optics by Max Born and Emil Wolf, 7th Ed. Cambridge University Press, 2019.
- ➢ A Textbook of Optics by Subrahamanyam and Brij Lal, S. Chand & Co., 25th Revised Ed., 2006.
- ➢ An Introduction to Fiber Optics by Ghatak and Thyagrajan, Cambridge University Press, 1988.

Online Learning resources:

- https://ocw.mit.edu/courses/2-71-optics-spring-2009/
- https://onlinecourses.nptel.ac.in/noc20_ph07/preview

Question Paper Template

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

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• interpret diffraction and polarization of light and use diffraction grating to determine wavelength of light		√	√		√	
• classify resolving power of various optical instruments	√	√			√	√
• identify various methods of polarizing an unpolarised light and use optical activity and apply it to solve problems	√	√				
• recall the phenomena such as reflection, refraction and total internal reflection and extract the structure of optical fiber, their properties, its significance in context to communication	√	√	√		√	
• identify the importance of glass fibers and examine attenuations and their effect while using optical fibers in communication	√	√			√	√
• relate multimode fibers and their significance in communication and inspect power law profile of various optical fibers.	√	√			√	√

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

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Electronics
COURSE CODE: PHYMJ-S3P6-2CR25 [CREDITS - 02]

CC VI	Course Code: PHYMJ-S3P6-2CR25
	Course Learning Outcomes

At the end of this course, learners will be able to
- compare the biasing of transistors for its appropriate applications
- interpret characteristics of JFETs and MOSFETs
- use CMOS for appropriate purposes
- interpret the working of differential and operational amplifiers
- design oscillators and use them in various applications
- design different kinds of multivibrators using IC 555.

Unit-I	Basic Electronics	[15L]

Learning Objectives:

This unit is intended to make the learners
- understand various biasing methods for a transistor
- study JFETs, MOSFETs and CMOS and its characteristics
- learn JFET and MOSET amplifiers and its applications.

Learning Outcomes:

At the end of this unit, learners will be able to
- compare the biasing of transistors for its appropriate applications
- interpret characteristics of JFETs and MOSFETs
- use CMOS for appropriate purposes.

1.1	**Transistor biasing:** Emitter Bias (7.1), Voltage Divider Bias (7.5), Accurate VDB analysis (7.6), VDB load line and Q-point (7.7).	[3L]
1.2	**JFETs:** JFET basic ideas (11.1), Drain curve (11.2), The trans-conductance curve (11.3), Biasing in Ohmic region (11.4), Biasing in active region (11.5), trans-conductance (11.6), JFET Amplifier (11.7), The JFET Analog Switch (11.8), Other JFET Applications (11.9).	[7L]
1.3	**MOSFETs:** The Depletion-Mode MOSFET (12.1), D-MOSFET Curves (12.2), Depletion-Mode MOSFET Amplifiers (12.3), The Enhancement-Mode MOSFET (12.4), The Ohmic Region (12.5), Digital Switching (12.6), CMOS (12.7).	[5L]

Text book:

Electronic Principles, Albert Malvino, David J. Bates, McGraw Hill Education (India) Private Limited, 8th Ed., 2016.

Unit II	Active Electronic Devices	[15L]

Learning Objectives:

This unit is intended to make the learners
- familiarize with differential and operational amplifiers
- understand various amplifications of Op Amp

• study different types of oscillators and understand the working of IC 555 timer IC and its applications.		

Learning Outcomes:

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

- interpret the working of differential and operational amplifiers
- design oscillators and use them in various applications
- design different kinds of multivibrators using IC 555.

2.1	**The Differential Amplifier:** The Differential Amplifier (15.1), DC Analysis of a Diff Amp (15.2), AC Analysis of a Diff Amp (15.3), Input Characteristics of an Op Amp (15.4), Common-Mode Gain (15.5).	**[4L]**
2.2	**Operational Amplifiers:** Introduction to Op Amps (16.1), The 741 Op Amp (16.2), The Inverting Amplifier (16.3), The Non-Inverting Amplifier (16.4), Two Op-Amp Applications (16.5).	**[4L]**
2.3	**Oscillators:** Theory of Sinusoidal Oscillation (21.1), The Wein bridge oscillator (21.2), Other RC oscillators (21.3), The Colpitts oscillator (21.4), other LC oscillator (21.5), The 555 timer (21.7), Astable operation of the 555 timer (21.8), 555 circuit applications (21.9).	**[7L]**

Text book:

Electronic Principles, Albert Malvino, David J Bates, McGraw Hill Education (India) Private Limited, 8th Ed., 2016.

Reference Books:

- ➢ Electronic devices and circuits: An Introduction by Allen Mottershead, Prentice Hall India Learning Private Limited, 1979.
- ➢ Microelectronics by Millman and Grabel, McGraw Hill Education, 2nd Ed., 2017
- ➢ Integrated Electronics by Millman and Halkias, McGraw Hill Education, 2nd Ed. 2001
- ➢ Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, 4th Ed., Pearson Education, 2015.
- ➢ Basic Electronics: Solid State by B L Theraja, S Chand, 2006

Online Learning resources:

- https://onlinecourses.nptel.ac.in/noc23_ee65/preview
- http://hyperphysics.phy-astr.gsu.edu/hbase/Solids/trans2.html#c1
- https://archive.nptel.ac.in/courses/117/108/117108038/

Question Paper Template

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

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• compare the biasing of transistors for its appropriate applications	√	√	√		√	√
• interpret characteristics of JFETs and MOSFETs	√	√	√		√	
• use CMOS for appropriate purposes	√		√			
• interpret the working of differential and operational amplifiers	√	√			√	
• design oscillators and use them in various applications	√	√				
• design different kinds of multivibrators using IC 555	√	√	√		√	√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Mathematical Methods and Quantum Mechanics
COURSE CODE: PHYMJ-S3P7-4CR25 [CREDITS - 04]

CC VII	Course Code: PHYMJ-S3P7-4CR25
	Course Learning Outcomes

At the end of this course, learners will be able to
- outline the properties of complex variables
- apply the concepts of Fourier series to perform graphical representation of different periodic functions
- apply numerical methods to solve algebraic and transcendental equations.
- apply the numerical methods to interpolate the data and solve the integrals.
- recall the old atomic models and classify atomic spectra and explain their origin
- interpret the correspondence principle and examine the effect of nuclear motion on atomic spectra
- distinguish between Classical Mechanics and Quantum Mechanics and relate the concept of wave function of a particle and its properties.
- determine expectation value of an observable within the given interval and extract the significance of operators of some physical quantities/observables in Quantum Mechanics.

Unit I	Mathematical Physics	[15L]

Learning Objectives:
This unit is intended to make the learners
- familiarize with the concepts of complex variables and its properties
- learn the Fourier series expansion of various periodic functions

Learning Outcomes:
At the end of this unit, learners will be able to
- outline the properties of complex variables
- apply the concepts of Fourier series to perform graphical representation of various functions

1.1	**Complex variables:** Functions of complex variable (12), mapping (13), limits (15), theorems on limits (16), continuity (18), derivatives (19), differentiation formulas (20), Cauchy-Riemann equations (21), Analytic functions (24).	[7L]
1.2	**Fourier series:** Fourier series - orthogonality of the trigonometric systems - convergence and sum of a Fourier series - graphical representation - Dirichlet's conditions - discontinuous functions (11.1), even and odd functions - half-range expansions - change of interval - functions of arbitrary periods (11.2).	[8L]

Text Books:
1. Complex Variables and Applications by J W Brown and R. V. Churchill, McGraw-Hill Book Co., 8th Ed., 2017.

2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons Inc., 10th Ed., 2010.

Unit II	Numerical Methods	[15L]

Learning Objectives:

This unit is intended to make the learners

- familiarize with various methods of solving algebraic and transcendental equations
- familiarize with various methods of interpolation.

Learning Outcomes:

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

- apply numerical methods to solve algebraic and transcendental equations
- prioritize the numerical methods to interpolate the data and solve the integrals.

2.1	Bisection method (2.2), method of False-Position (2.3), Iteration method (2.4), Newton-Raphson method (2.5).	[5L]
2.2	Introduction, (3.1) errors in polynomial interpolation (3.2), finite differences (3.3), differences of a polynomial (3.5), Newton's formulae for interpolation (3.6), Newton's General Interpolation Formula (3.10.1).	[6L]
2.3	Numerical Integration, general formula - Rectangular rule (6.4), Trapezoidal rule (6.4.1), Simpson's 1/3 rule (6.4.2).	[4L]

Text book:

Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Private Limited, 5th Ed., 2018.

Unit III	Atomic Structure	[15L]

Learning Objectives:

This unit is intended to make the learners

- familiarize with different types of atomic spectra and explain their origin
- understand Bohr's model in detail and study the correspondence principle and its significance.

Learning Outcomes:

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

- recall the old atomic models and classify atomic spectra and explain their origin
- interpret the correspondence principle and examine the effect of nuclear motion on atomic spectra

3.1	The nuclear atom, Rutherford Scattering Formula, Nuclear Dimensions (4.1), electron orbits, The Failure of Classical Physics (4.2), atomic spectra, Spectral Series (4.3), the Bohr atom (4.4), energy levels and atomic spectra, Origin of Line Spectra (4.5), correspondence principle (4.6), nuclear motion (4.7), atomic excitation, Franck-Hertz Experiment (4.8).	[15L]

Text book:

Concepts of Modern Physics by A. Beiser, McGraw-Hill Higher Education, 6th Ed., 2002.

Unit IV	Quantum Mechanics	[15L]

Learning Objectives:

This unit is intended to make the learners

	• familiarize with the concept of wave function of a particle and its properties	
	• use Schrodinger's Equation in various potentials.	

Learning Outcomes:

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

- distinguish between Classical Mechanics and Quantum Mechanics and relate the concept of wave function of a particle and its properties.
- determine expectation value of an observable within the given interval and extract the significance of operators of some physical quantities/observables in Quantum Mechanics.

4.1	Quantum Mechanics (5.1), Wave Equation (5.2), Schrodinger's Equation: Time Dependent Form (5.3), Linearity and Superposition (5.4), Expectation Values (5.5), Operators (5.6), Schrodinger's Equation: Steady-State Form (5.7), Particle in Box (5.8), Finite Potential (5.9), Tunnel Effect (5.10), Harmonic Oscillator (5.11).	**[15L]**

Text book:

Concepts of Modern Physics by A. Beiser, McGraw-Hill Higher Education, 6th Ed., 2002.

Reference Books:

- ➢ Mathematical Methods in the Physical Sciences by Mary L. Boas, Wiley, 3rd Ed., 2006
- ➢ Schaum's Outline of Complex Variables, McGraw Hill, 2nd Ed., 2009 .
- ➢ Mathematical Physics by B. S. Rajput by Anu Books, 2020.
- ➢ Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge University Press; 3rd Ed., 2006.
- ➢ Modern Physics by Jeremy Bernstein, Paul M. Fishbane, Stephen G. Gasiorowicz, Pearson, 2000.
- ➢ Modern Physics by Kenneth S. Krane, John Wiley & Sons, 3rd Ed., 2012.
- ➢ Modern Physics by Raymond Serway, Curt Moyer, Clement Moses, Brooks/Cole; 3rd Ed., 2020.

Online Learning resources:

- https://archive.nptel.ac.in/courses/111/103/111103070/
- https://archive.nptel.ac.in/courses/111/107/111107098/ [Lecture-47 onwards]
- https://onlinecourses.nptel.ac.in/noc23_ph16/preview
- https://onlinecourses.nptel.ac.in/noc24_ph15/preview
- https://onlinecourses.swayam2.ac.in/aic22_ts14/preview

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	-	20%	30%	30%	20%	-	100%
II	-	20%	30%	30%	20%	-	100%
III	20%	40%	20%	20%	-	-	100%
IV	20%	30%	20%	20%	10%	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• outline the properties of complex variables	√	√	√		√	√
• apply the concepts of Fourier series to perform graphical representation of different periodic functions	√	√	√		√	
• apply numerical methods to solve algebraic and transcendental equations.	√		√			
• apply the numerical methods to interpolate the data and solve the integrals.	√	√				√
• recall the old atomic models and classify atomic spectra and explain their origin	√	√			√	
• interpret the correspondence principle and examine the effect of nuclear motion on atomic spectra	√	√				
• distinguish between Classical Mechanics and Quantum Mechanics and relate the concept of wave function of a particle and its properties.	√	√	√		√	√
• determine expectation value of an observable within the given interval and extract the significance of operators of some physical quantities/observables in Quantum Mechanics.	√	√				√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Physics Practical - V
COURSE CODE: PHYMJ-S3PR5-2CR25 [CREDITS - 02]

Practical V	Course Code: PHYMJ-S3PR5-2CR25
	Course Learning Outcomes

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

- demonstrate practical skills
- utilize Physics theory concepts with practical

1	To calculate the displacement, velocity and acceleration of the given SHO and plot the graphs of these quantities as a function of time.
2	To study simple and damped harmonic motions.
3	To determine "Y" of the given specimen by the method of elevation.
4	To determine self-inductance of an inductor using Maxwell's bridge.
5	To determine ratio of two capacitances using de Sauty's bridge.
6	To determine figure of merit of a BG.
7	To find resonance frequency of an LCR ac series network.
8	To study oscillations of series combination of two springs.
9	To determine moment of inertia of a flywheel.
10	To determine the resultant focal length of a system of two thin lenses.
11	To determine low resistance by the method of projection of potential using Wheatstone bridge.
12	To study thermocouple.
13	To verify the parallel axis theorem of moment of inertia.
14	To study characteristics of a photodiode.

Reference Books:

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

Online Learning resources:

- https://phet.colorado.edu/
- https://www.olabs.edu.in/
- https://vlab.amrita.edu/index.php?sub=1
- https://alllabexperiments.com/physics_practical_files/

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.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme specific Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
• demonstrate practical skills	√	√	√	√	√	√
• utilize Physics theory concepts with appropriate practical	√	√			√	

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Physics Practical - VI
COURSE CODE: PHYMJ-S3PR6-2CR25 [CREDITS - 02]

Practical VI	Course Code: PHYMJ-S3PR6-2CR25
	Course Learning Outcomes

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

- demonstrate practical skills
- utilize Physics theory concepts through practical

1	To verify Stefan' s fourth power law.
2	To determine wavelength of spectral lines of a mercury source by using plane transmission grating. (Minimum deviation method).
3	To verify Malus' Law.
4	To verify Brewster' s Law.
5	To determine wavelength of lasers of different colours using plane diffraction grating.
6	To determine Cauchy's constants.
7	To perform VDB DC analysis for the CE configuration of a BJT.
8	To determine Boltzmann's constant using a PN junction diode.
9	To study AC analysis of emitter-biased amplifier.
10	To study the diffraction pattern due to a single slit and determine the wavelength of monochromatic light.
11	To determine absorption coefficient of the given liquid.
12	To determine moment of inertia of different specimen using bifilar suspension method.
13	To verify the perpendicular axis theorem of moment of inertia for a laminar body.
14	To study characteristics of a photo-transistor.

Reference Books:
- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, Asia Publishing House, New Delhi, 3rd Ed., 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, Himalayan Publishing House, 1st Ed., 2000.
- A Laboratory Manual of Physics for Undergraduate Classes by D. P. Khandelwal, Vani Publication House, New Delhi, 1st Ed., 1985.
- B. Sc. Practical Physics by Geeta Sanon, R. Chand & Co., 1st Ed., 2007.

Online Learning resources:
- https://www.olabs.edu.in/

- https://vlab.amrita.edu/index.php?sub=1
- https://alllabexperiments.com/physics_practical_files/

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.

Mapping of CLOs and PSOs

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

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

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Numerical Analysis
COURSE CODE: PHYMDC-S3P4-4CR25 [CREDITS - 04]

MDC IV	Course Code: PHYMDC-S3P4-4CR25	
	Course Learning Outcomes	

At the end of this course, learners will be able to
- interpret the origin of errors
- apply Bisection method, method of False-Position, Iteration method, Newton-Raphson method, Ramanujan's method and Secant method to solve algebraic and transcendental equations
- apply Newton's forward, backward and central difference methods, Lagrange's method and Newton's divided difference method to interpolate the data
- identify the errors in interpolating the data
- apply Newton's forward and backward methods to evaluate the first and second order derivatives
- identify the errors in numerical differentiation
- apply Trapezoidal rule, Simpson's 1/3 rule , Simpson's 3/8 rule, Boole's rules - Weddle's rules and Newton-Cotes integration formulae to solve the integrals
- identify the errors in numerical integration.

Unit I	Algebraic and Transcendental Equations	[15L]

Learning Objectives:

This unit is intended to make the learners
- familiarize with the concept of errors and various methods of solving algebraic and transcendental equations.

Learning Outcomes:

At the end of this unit, learners will be able to
- interpret the origin of errors
- apply numerical methods to solve algebraic and transcendental equations.

1.1	Errors and their computations - absolute error, relative error, probable error and percentage error (1.3), general error formula (1.4).	[3L]
1.2	Bisection method (2.2), method of False-Position (2.3), Iteration method (2.4), Newton-Raphson method (2.5), Ramanujan's method (2.6), Secant method (2.7).	[12L]

Text Book:

Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Private Limited, 5th Ed., 2018.

Unit II	Interpolation	[15L]

Learning Objectives:

This unit is intended to make the learners
- familiarize with various methods of interpolation.

Learning Outcomes:

	At the end of this unit, learners will be able to	
	• apply the numerical methods to interpolate the data	
	• identify the errors in interpolating the data.	
2.1	Introduction, (3.1) errors in polynomial interpolation (3.2), finite differences (3.3), forward differences (3.3.1), backward differences (3.3.2), central differences (3.3.3), symbolic relations and separation of symbols (3.3.4), differences of a polynomial (3.5), Newton's formulae for interpolation (3.6), interpolation with unevenly spaced points (3.9), Lagrange's interpolation ((3.9.1), Newton's General Interpolation Formula (3.10.1).	**[15L]**

Text Book:

Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Private Limited, 5th Ed., 2018.

Unit III	Numeric Differentiation	[15L]

Learning Objectives:

This unit is intended to make the learners

- study various numerical methods to differentiate various functions.

Learning Outcomes:

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

- apply the numerical methods to evaluate the first and second order derivatives
- identify the errors in numerical differentiation.

3.1	Introduction (6.1), numerical differentiation - Newton's forward difference formula - Newton's backward difference formula - calculation of the first and second derivatives (6.2), errors in numerical differentiation (6.2.1), differentiation formulae with function values (6.2.3).	**[15L]**

Text Book:

Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Private Limited, 5th Ed., 2018.

Unit IV	Numeric Integration	[15L]

Learning Objectives:

This unit is intended to make the learners

- study various numerical methods to integrate various functions.

Learning Outcomes:

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

- apply the numerical methods to solve the integrals
- identify the errors in numerical integration.

4.1	Numerical Integration, general formula - Rectangular rule (6.4), Trapezoidal rule (6.4.1), Simpson's 1/3 rule (6.4.2), Boole's rules - Weddle's rules (6.4.4), Newton-Cotes integration formulae (6.4.7).	**[15L]**

Text Book:

Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Private Limited, 5th Ed., 2018.

Reference Books:

➢ Numerical methods for engineers by Steven C. Chapra and Raymond P. Canale, McGraw Hill Higher Education, 2009.

➢ Numerical Methods for Scientific and Engineering Computations by M. K. Jain, S. R. K. Iyenger and R. K. Jain, New-Age International Ltd, 7th Ed., 2019.

➢ Numerical Methods and Analysis by James I. Buchanan and Peter R. Turner, McGraw Hill Book Co., 1992

➢ Advanced Engineering Mathematics by Erwin Kreyszig, Wiley 10th Ed., 2011.

Online Learning resources:

● https://onlinecourses.nptel.ac.in/noc23_ma44/preview
● https://archive.nptel.ac.in/courses/111/106/111106101/

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	60%	-	-	-	100%
II	10%	30%	60%	-	-	-	100%
III	10%	30%	60%	-	-	-	100%
IV	10%	30%	60%	-	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
● interpret the origin of errors	√	√			√	√
● apply Bisection method, method of False-Position, Iteration method, Newton-Raphson method, Ramanujan's method and Secant method to solve algebraic and transcendental equations	√	√	√		√	√
● apply Newton's forward, backward and central difference methods, Lagrange's method and	√	√	√		√	√

Newton's divided difference method to interpolate the data						
• identify the errors in interpolating the data	√	√			√	√
• apply Newton's forward and backward methods to evaluate the first and second order derivatives	√	√	√		√	√
• identify the errors in numerical differentiation	√	√			√	√
• apply Trapezoidal rule, Simpson's 1/3 rule , Simpson's 3/8 rule, Boole's rules - Weddle's rules and Newton-Cotes integration formulae to solve the integrals	√	√	√		√	√
• identify the errors in numerical integration	√	√			√	√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Biomedical Instrumentation
COURSE CODE: PHYMDC-S3P5-4CR25 [CREDITS - 04]

MDC V	Course Code: PHYMDC-S3P5-4CR25
	Course Learning Outcomes

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

- interpret the bio-sensors and its types of their properties, behaviours and practical applications.
- summarize the construction and working electrochemical electrodes
- extract the basics of nano-sensors and their measurement techniques
- relate the fabrication methods and its real-world applications
- extract basic principles and importance of optical measurement techniques in scientific and industrial applications.
- discover the role of spectroscopy in chemical analysis, biomedical applications and environmental monitoring
- interpret the working of detectors, filters, chromatography and electrochemical sensors
- relate the principles of Nuclear Magnetic Resonance (NMR) and X-ray spectrometers in real-world scenarios.

Unit I	Bio-sensors	[15L]

Learning Objectives:

This unit is intended to make the learners

- provide a comprehensive understanding of the fundamental biosensors, their characteristics and their applications.

Learning Outcomes:

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

- interpret the bio-sensors and its types of their properties, behaviours and practical applications.
- summarize the construction and working electrochemical electrodes

1.1	Introduction of sensors (32.1), Types of modern sensors (32.2), Nano-technology (32.2.1), Biocatalyst (32.2.2), Enzymes (32.2.2), Isolation of Microorganism (32.2.4), Immobilization (32.2.5), Bio-sensor (32.2.6), Glucose Electrode (32.2.7), Electrochemical electrode (32.2.8)	[15L]

Text Book:

A Course in Electrical and Electronic Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co; 19th Ed., 2020.

Unit II	Nano-sensors	[15L]

Learning Objectives:

This unit is intended to make the learners

- understand fundamentals of nanostructures and their properties.
- build a solid foundation of understanding of nano-sensors and nanotechnology.
- understand the fundamental principles behind nanostructure measurement techniques.
- understand different techniques used for fabricating nanostructures.

	• define and understand the working principles of nano-scale sensors.	

Learning Outcomes:

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

- extract the basics of nano-sensors and their measurement techniques
- relate the fabrication methods and its real-world applications.

2.1	Nano-sensors: Measurement of nanostructures (32.3.1), Generation of Nan- structures (32.3.2), Nano-scale sensors (32.3.3), Biosensors (32.4), Advance instrumentation techniques (32.5), Virtual instruments (32.5.1), Intelligent instrumentation (32.6), Digital three phase real power and energy measurement (32.7).	**[15L]**

Text Book:

A Course in Electrical and Electronic Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co; 19th Ed., 2020.

Unit III	**Chemical Sensors**	**[15L]**

Learning Objectives:

This unit is intended to make the learners

- get a solid foundation for understanding spectroscopy, its instrumentation and its applications.
- understand the fundamental concepts of spectroscopy.
- understand the functioning of probanalyzers in spectroscopy.
- learn the principle of differential reflectometry and its significance.
- explore different branches of spectroscopy.
- understand different radiation sources used in spectroscopy.

Learning Outcomes:

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

- extract basic principles and importance of optical measurement techniques in scientific and industrial applications.
- discover the role of spectroscopy in chemical analysis, biomedical applications and environmental monitoring.

3.1	Introduction (34.1), Probanalizers (34.2), Differential reflectometers (34.3), Spectrophotometers (34.4), Different aspects for aspects of spectroscopy (34.4.1), Source of radiation and detectors for spectrophotometers (34.4.2).	**[15L]**

Text Book:

A Course in Electrical and Electronic Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co; 19th Ed., 2020.

Unit IV	**Analytical Instruments**	**[15L]**

Learning Objectives:

This unit is intended to make the learners

- develop a strong foundation in analytical instrumentation and sensor technologies.
- understand the role of detectors in analytical instruments and their importance in signal measurement.
- learn the function of optical filters in spectroscopic and imaging applications.

- learn the principles of electrochemical sensing and the types of electrochemical sensors.
- understand the basic principle of Nuclear Magnetic Resonance (NMR) spectroscopy.
- learn the fundamental principles of X-ray spectrometry and its role in material characterization.
- gain knowledge of various analytical sensors beyond electrochemical and optical sensors.

Learning Outcomes:

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

- interpret the working of detectors, filters, chromatography and electrochemical sensors
- relate the principles of Nuclear Magnetic Resonance (NMR) and X-ray spectrometers in real-world scenarios.

4.1	Detectors (34.5), Filters (34.6), Chromatography (34.7), Electrochemical sensors (34.8), Nernst equation (34.9), Nuclear Magnetic Resonance (NMR) (34.9), X-ray spectrometers (34.10), Other analytical sensors (34.11).	**[15L]**

Text Book:

A Course in Electrical and Electronic Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co; 19th Ed., 2020.

Reference Books:

- Handbook of Biomedical Instrumentation by R. S. Khandpur, McGraw Hill Education, 3rd Ed., 2004.
- Electronic Instrumentation and Measurements by H. S. Kalsi, McGraw Hill Education, 4th Ed., 2019.

Online Learning resources:

- https://archive.nptel.ac.in/courses/108/105/108105064/

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	60%	-	-	-	100%
II	10%	30%	60%	-	-	-	100%
III	10%	30%	60%	-	-	-	100%
IV	10%	30%	60%	-	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
• interpret the bio-sensors and its types of their properties, behaviours and practical applications.	√	√	√		√	
• summarize the construction and working electrochemical electrodes	√	√	√		√	√
• extract the basics of nano-sensors and their measurement techniques	√	√	√		√	√
• relate the fabrication methods and its real-world applications	√	√			√	√
• extract basic principles and importance of optical measurement techniques in scientific and industrial applications.	√	√	√		√	
• discover the role of spectroscopy in chemical analysis, biomedical applications and environmental monitoring	√	√			√	
• interpret the working of detectors, filters, chromatography and electrochemical sensors	√	√				
• relate the principles of Nuclear Magnetic Resonance (NMR) and X-ray spectrometers in real-world scenarios	√	√	√		√	√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Plasma Science
COURSE CODE: PHYMDC-S3P6-4CR25 [CREDITS - 04]

MDC VI	COURSE CODE: PHYMDC- S3P6-4CR25
	Course Learning Outcomes

At the end of this course, students will be able to
- understand the plasma fundamentals, including temperature concepts, Debye shielding, Poisson's equation and plasma criteria
- apply the basic concepts of plasma to solve numericals
- apply plasma principles in gas discharges, fusion and space physics
- relate the applications of plasma in astrophysics, MHD conversion, accelerators and industries
- interpret various energy sources, including fossil fuels, nuclear, hydro, wind and solar power.
- relate the existing energy sources in the context of global energy needs
- apply plasma confinement principles to fusion energy, ITER and DEMO
- identify the advancements in plasma physics research for sustainable energy solutions.

Unit I	Basics of Plasma	[15L]

Learning objective:
This unit is intended to make the learners
- aware of the basics of plasma, its occurrence, key equations, temperature concepts and fundamental criteria.

Learning outcome:
At the end of this unit, learners will be able to
- understand the plasma fundamentals, including temperature concepts, Debye shielding, Poisson's equation and plasma criteria
- apply the basic concepts of plasma to solve numericals.

1	Occurrence of plasmas in Nature – Saha equation (1.1), definition of plasma (1.2), concept of temperature – Maxwellian velocity distribution (1.3), Debye shielding (1.4) – Poisson's equation, the plasma parameter (1.5), criteria for plasmas (1.6), problems.	[15L]

Text Book:
Introduction to Plasma Physics and Controlled Fusion by F. F. Chen, 3rd Ed., Springer Nature, 2016.

Unit II	Applications of Plasma	[15L]

Learning objective:
This unit is intended to
- infer the concepts of applications of plasmas in different areas of science and technology.

Learning outcome:
At the end of this unit, learners will be able to
- apply plasma principles in gas discharges, fusion and space physics

	• relate the applications of plasma in astrophysics, MHD conversion, accelerators and industries.	
2	Gas discharges (Gaseous Electronics) (1.7.1), controlled thermonuclear fusion (1.7.2), space physics (1.7.3), modern astrophysics (1.7.4), MHD conversion and ion propulsion (1.7.5), solid state plasmas (1.7.6), gas lasers (1.7.7), particle accelerators (1.7.8), industrial plasmas (1.7.9), atmospheric plasmas (1.7.10).	**[15L]**

Text Book:

Introduction to Plasma Physics and Controlled Fusion by F F Chen, 3rd Ed., Springer Nature, 2016.

Unit III	**Fusion and World Energy**	**[15L]**

Learning objective:

This unit is intended to make the learners

  • aware about various energy sources in the context of global energy needs.

Learning outcome:

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

  • interpret various energy sources, including fossil fuels, nuclear, hydro, wind and solar power.
  • relate the existing energy sources in the context of global energy needs.

3	**Fusion and world energy:** introduction (1.1), the existing energy options – background (1.2.1), coal - fossil fuel power plant (1.2.2), natural gas (1.2.3), oil (1.2.4), nuclear power (1.2.5), hydroelectric power (1.2.6), wind power (1.2.7), solar power (1.2.8).	**[15L]**

Text Book:

Plasma Physics and Fusion Energy by Jeffrey P. Freidberg, Cambridge University Press, 1st Ed., 2008.

Unit IV	**Plasma for Fusion Power**	**[15L]**

Learning objective:

This unit is intended to make the learners

  • illustrate the concepts of plasma confinement for sustainable energy solutions.

Learning outcome:

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

  • apply plasma confinement principles to fusion energy, ITER and DEMO
  • identify the advancements in plasma physics research for sustainable energy solutions.

4	**The role of fusion energy:** fusion energy (1.3.1), single particle behaviour - plasma confinement (6.3), current status of plasma physics research (16.2), International Thermonuclear Experimental Reactor (ITER) (16.3), history (16.3.1), the new ITER (16.3.2), a demonstration power plant (DEMO) (16.4).	**[15L]**

Text Book:

Plasma Physics and Fusion Energy by Jeffrey P. Freidberg, Cambridge University Press, 1st Ed., 2008

Reference Books:

➤ Principles of Plasma Discharges and Materials Processing by Michael A. Lieberman and Alan J. Lichtenberg, Wiley-Interscience, 2nd Ed., 2005.
➤ Principles of Plasma Physics by Nicholas A. Krall, Alvin W. Trivelpiece and Robert A. Gross, McGraw-Hill, 1973.

Online Learning resources:
- **https://onlinecourses.nptel.ac.in/noc24_ph20/preview**

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	40%	30%	-	-	-	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
• understand the plasma fundamentals, including temperature concepts, Debye shielding, Poisson's equation and plasma criteria	√	√	√		√	√
• apply the basic concepts of plasma to solve numericals	√	√	√			
• apply plasma principles in gas discharges, fusion and space physics	√	√			√	
• relate the applications of plasma in astrophysics, MHD conversion, accelerators and industries	√	√			√	
• interpret various energy sources, including fossil fuels, nuclear, hydro, wind and solar power.	√	√	√		√	√
• relate the existing energy sources in the context of global energy needs	√	√	√			
• apply plasma confinement principles to fusion energy, ITER and DEMO	√	√	√		√	
• identify the advancements in plasma physics research for sustainable energy solutions	√	√	√			√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Applications of Differential Equations
COURSE CODE: PHYMDC-S3P7-4CR25 [CREDITS - 04]

MDC VII	COURSE CODE: PHYMDC-S3P7-4CR25
	Course Learning Outcomes

At the end of this course, students will be able to
- apply differential equations for solving problems in electrical circuits
- apply differential equations for solving mechanical engineering problems
- outline differential equations for solving problems on simple harmonic motions with damping
- outline differential equations for solving problems on simple harmonic motions without damping
- identify applications of differential equations in biological domain
- identify applications of differential equations in the field of chemistry
- examine the historical examples of applications of differential equations for solving complex problems
- apply differential equations for studying population growth.

Unit I	Applications of Differential Equations-I	[15L]

Learning objectives:
This unit is intended to make the learners
- familiarize with the basic concepts of applications of differential equation in electrical circuit and mechanical engineering problems.

Learning outcomes:
At the end of this unit, learners will be able to
- apply differential equations for solving problems in electrical circuits
- apply differential equations for solving mechanical engineering problems.

1	**Electrical circuit problems** – LR circuits, RC circuits, LCR circuits. **Mechanical engineering problems** – rectilinear motion, vertical motion, vertical elastic string, horizontal elastic string, bending of a beam – supported beam, fixed beam, cantilever.	[15L]

Text Book:
Mathematical Physics by H K Dass, Rama Verma, S Chand Publishing, 8th Ed., 2019.

Unit II	Applications of Differential Equations-II	[15L]

Learning objectives:
This unit is intended to make the learners
- study the differential equations for solving problems on simple harmonic motions.

Learning outcome:
At the end of this unit, learners will be able to
- outline differential equations for solving problems on simple harmonic motions with damping

- outline differential equations for solving problems on simple harmonic motions without damping.

| 2 | Problems on simple harmonic motion, simple pendulum, oscillations of a spring: (i) Free oscillations (ii) Damped free oscillations – overdamping, underdamping, critical damping (iii) Forced oscillations (without damping) (iv) Forced oscillations (with damping). | **[15L]** |

Text Book:

Mathematical Physics by H. K. Dass, Rama Verma, S. Chand Publishing, 8th Ed., 2019.

| Unit III | Applications of Differential Equations-III | [15L] |

Learning objectives:

This unit is intended to make the learners

- study the applications of differential equations in biological domain.

Learning outcome:

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

- identify applications of differential equations in biological domain
- identify applications of differential equations in the field of chemistry.

| 3 | Problems on Radiocarbon dating, Newton's law of cooling, Torricelli's law (leaking of tank), Mixing problem in industries, Bacterial growth, Linear accelerators, Gompertz growth in tumors, Modeling the hormone level in the blood, diffusion of drug in blood tream, Air circulation, Boyle-Mariotte's law for ideal gas, Dryer, Rocket. | **[15L]** |

Text Book:

Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, 10th Ed., 2011.

| Unit IV | Applications of Differential Equations-IV | [15L] |

Learning objectives:

This unit is intended to make the learners

- study the historical examples of applications of differential equations for solving complex problems.

Learning outcome:

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

- examine the historical examples of applications of differential equations for solving complex problems
- apply differential equations for studying population growth.

| 4 | The Van Meegeren art forgeries, Washing of Feet, Woman Reading Music, Woman Playing Mandolin, Lace Maker, Laughing Girl, Malthusian law of population growth, Model of the population growth of the United States by Pearl and Reed, World Population. | **[15L]** |

Text Book:

Differential Equations and Their Applications by Martin Braun, Springer-Verlag New York Inc., 4th Ed., 1993.

Reference Books:
- ➢ Introductory Course in Differential Equations by D A Murray, Andesite Press 2015.
- ➢ Mathematical Methods in the Physical Sciences by M L Boas, Wiley, 3rd Ed., 2006.
- ➢ Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge University Press; 3rd Ed., 2006.

Online Learning resources:
- • https://archive.nptel.ac.in/courses/111/106/111106100/

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	20%	20%	60%	-	-	-	100%
II	20%	20%	60%	-	-	-	100%
III	20%	20%	60%	-	-	-	100%
IV	20%	20%	40%	20%	-	-	100%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
• apply differential equations for solving problems in electrical circuits	√	√	√		√	√
• apply differential equations for solving mechanical engineering problems	√	√				√
• outline differential equations for solving problems on simple harmonic motions with damping	√	√	√		√	
• outline differential equations for solving problems on simple harmonic motions without damping	√	√	√		√	√
• identify applications of differential equations in biological domain	√	√	√		√	
• identify applications of differential equations in the field of chemistry	√	√	√		√	
• examine the historical examples of applications of differential equations for solving complex problems	√	√	√			√
• apply differential equations for studying population growth	√	√	√		√	

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Programming in "C" Language - III
COURSE CODE: PHYSEC-S3P4-2CR25 [CREDITS - 02]

SEC IV	Course Code: PHYSEC-S3P4-2CR25
	Course Learning Outcomes

Learning objectives:

This unit is intended to make the learners

- understand how to declare and initialize one-dimensional and multi-dimensional arrays in C
- learn how to access and manipulate array elements using indexing and addressing techniques
- understand how to perform basic array operations, such as searching, sorting and reversing arrays
- learn how to pass arrays to functions and return array values from functions.

Learning outcomes:

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

- demonstrate practical skills
- utilize the programming theory concepts with appropriate practical
- apply numerical algorithms into C-program and visualize the results of the computations.

To formulate algorithm, draw a flow chart and write a program for the following:	[60L]
1	To find the roots of the equation using Newton-Raphson method.	
2	To use Lagrange interpolation for interpolating a polynomial from a set of data points.	
3	To study one dimensional dynamics of motion of falling objects (ideal case).	
4	To study one dimensional dynamics of motion of falling objects (considering drag force).	
5	To study one dimensional dynamics of an oscillator (spring) without damping.	
6	To study one dimensional dynamics of an oscillator (spring) with damping.	
7	To study motion of an accelerating car (constant acceleration)	
8	To study motion of an accelerating car (a matter of Horse Power)	
9	To study motion of an accelerating car (considering Air resistance and Rolling friction)	
10	Project work (equivalent to 5 experiments)	

Reference Books:
- Computer Programming in C by V. Rajaraman, PHI Learning Pvt. Ltd., 2nd Ed., 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. Two experiments are to be performed by each student per week.
- ➢ In the external exam, a student will have to perform one experiment and also needs to appear for project viva. 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**
• demonstrate practical skills	√	√	√		√	√
• utilize physics theory concepts with appropriate practical	√	√			√	
• apply numerical algorithms into C-program and visualize the results of the computations.	√	√	√		√	√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Basic Electronic Circuits and Designing – I
COURSE CODE: PHYSEC-S3P5-2CR25 [CREDITS - 02]

SEC V	COURSE CODE: PHYSEC-S3P5-2CR25
	Course Learning Outcomes

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

- apply the skills necessary for effective PCB design, leading to successful project implementation in various applications.
- use software to design the circuit.

Learning objectives:

This unit is intended to make the learners

- design a small project based on power supply.
- design simple projects using passive and active components.

Learning outcome:

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

- design, build and test and troubleshoot a circuit design built on PCB.

The following experiments are to be performed in design, build and test (DBT) mode:

	1. Verification of Kirchhoff's Voltage Law.	**[60 hr]**
	2. Verification of Kirchhoff's Current Law.	
	3. Verification of Superposition theorem	
	4. Verification of Thevenin's theorem.	
	5. Verification of Norton's theorem.	
	6. Study of a two-port network.	
	7. Study of V-I characteristics of a PN Junction Diode (under forward biased and reverse biased conditions)	
	8. Study of the V-I characteristics of a Zener Diode.	
	9. Study of half-wave rectifier and full-wave rectifier with T and π filters	
	10. Study of bridge rectifier with T and π filters	
	11. Study of basic logic gates and verification of their truth tables.	
	12. Study of universal gates and verification of their truth tables.	
	13. Study of Ex-OR gate and verification its truth table.	
	14. Study of half adder and full adder.	
	15. Study of half subtractor and full subtractor.	

Text Books:

1. Text Book Electrical Technology by B. L. Theraja, S Chand Co., 2014
2. A Text Book of Electronics by Santanu Chattopadhyay, New Central Book Agency (NCBA), 2nd Ed., 2016.

Online Learning Resources:

- https://be-iitkgp.vlabs.ac.in/

- https://de-iitr.vlabs.ac.in/

Note:

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

➢ In the external exam, a student will have to perform one experiment and also needs to appear for project viva. 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**
• apply the skills necessary for effective PCB design, leading to successful project implementation in various applications.	√	√	√		√	√
• use software to design the circuit	√	√	√		√	√

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Instrumentation Laboratory Skills - I
COURSE CODE: PHYSEC-S3P6-2CR25 [CREDITS - 02]

SEC VI	COURSE CODE: PHYSEC-S3P6-2CR25
	Course Learning Outcomes

At the end of this course, students will be able to
- apply skills necessary for effective instrumentation, leading to successful project implementation in various applications.
- use software to design the circuit.

Learning objectives:

This unit is intended to make the learners
- understand analog and digital measuring instruments
- understand working and usage of Cathode Ray Oscilloscope (CRO).

Learning outcomes:

At the end of this unit, learners will be able to
- use different analogue and digital meters
- use different transducers for measuring unknown quantity.

		[60L]
	1. To observe the loading effect of multi-meter while measuring the voltage across a low resistance and high resistance.	
	2. To determine impedance, inductive reactance and capacitive reactance of an LCR ac series network for different frequencies.	
	3. To observe the limitation of an AC voltmeter for measuring high frequency voltage and currents.	
	4. To measure Q-value of a coil and its dependence on frequency by using LCR series resonance circuit.	
	5. BCD to Seven Segment Display on digital multi-meter.	
	6. To study functioning of CRO.	
	7. To measure voltage, frequency, time-period, duty cycle and phase angle using CRO.	
	8. To measure rise-time (t_r), fall-time (t_f) and delay time using a CRO.	
	9. To study addition and subtraction using basic logic gates.	
	10. To introduce microprocessor 8085.	
	11. Project work	

Text Books:
1. A Text Book in Electrical Technology by B. L. Theraja, S Chand and Co. 2014.
2. Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney, Dhanpat Rai & Co., 19th Ed. 2020.

Online Learning Resources:
- https://sil-coep.vlabs.ac.in/
- https://nptel.ac.in/courses/108105064

Note:

- ➢ The duration of each experiment is of 2 hours. Two experiments are to be performed by each student per week.
- ➢ In the external exam, a student will have to perform one experiment and also needs to appear for project viva. 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
• apply skills necessary for effective instrumentation, leading to successful project implementation in various applications	√	√	√			
• use software to design the circuit	√	√	√			

B. Sc. (Physics) SEMESTER III
COURSE TITLE: Basics of Ancient Astronomy
COURSE CODE: PHYBKS-S3P1-2CR25 [CREDITS - 02]

BKS I	COURSE CODE: PHYBKS-S3P1-2CR25	
	Course Learning Outcomes	

At the end of this course, students will be able to
- describe the structure of the universe and solar system, identifying key celestial bodies and their roles.
- explain the basic features of astronomical observation, including precession of the equinox and advance of perihelion.
- analyze the motion of the Moon, lunar asterisms (Nakshatras), and the dynamics of the Sun and planets within various coordinate systems.
- demonstrate practical skills in naked-eye astronomy and effectively use instruments for celestial observation.

Unit I	**Basics of Positional Astronomy**	[15L]

Learning Objectives:

This unit is intended to make the learners
- study astronomy, covering the universe, solar system, and key components
- understand the features of astronomical observation, including precession of the equinox and advance of perihelion.

Learning Outcomes:

At the end of this unit, learners will be able to:
- describe the structure of the universe and solar system, identifying key celestial bodies and their roles
- explain the basic features of astronomical observation, including precession of the equinox and advance of perihelion.

1	Introduction, The Universe and The Solar System, Basic Features of Astronomical Observation, Precession of the Equinox and Advance of Perihelion.	[15L]

Text book:
- History of Science in India, Vol. I: Part II, Astronomy by Prof. Amitabha Ghosh, The National Academy of Sciences, India and The Ramkrishna Mission institute of Culture, Kolkata, 2017.

Unit II	**Sun and Moon**	[15L]

Learning Objectives:

This unit is intended to make the learners
- explore the motion of the Moon, lunar asterisms (Nakshatras), and planetary interactions in different coordinate systems
- teach naked-eye astronomy techniques and the use of observational instruments.

Learning Outcomes:

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

	• analyze the motion of the Moon, lunar asterisms (Nakshatras), and the dynamics of the Sun and planets within various coordinate systems	
	• demonstrate practical skills in naked-eye astronomy and effectively use instruments for celestial observation.	
2	Motion of the Moon and Lunar Asterisms-Nakhsatras, Sun and The Planets: Zodiacal Signs; Ecliptic System; Equatorial System; Horizontal System, Naked Eye Astronomy: Technique and Instruments.	**[15L]**

Text book:

  • History of Science in India, Vol. I: Part II, Astronomy by Prof. Amitabha Ghosh, The National Academy of Sciences, India and The Ramkrishna Mission institute of Culture, Kolkata, 2017.

Reference Books:

  ➢ Introduction to Indian Knowledge System: Concepts and Applications by B. Mahadevan, Nagendra Pavana, Vinayak Rajat Bhat. PHI Learning, 2022
  ➢ Indian Knowledge Systems: Vol. 1 & Vol. 2 by Kapil Kapoor and Awadhesh Kumar Singh. D.K. Print World Ltd., 1st Ed., 2005
  ➢ Introduction to Indian Knowledge System by Dr. Rohidas Nitonde, Notion Press, 2024.

Online Learning Resources:

  • https://archive.nptel.ac.in/courses/121/104/121104006/

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%

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes					
	1	2	3	4	5	6
• describe the structure of the universe and solar system, identifying key celestial bodies and their roles.	√	√				
• explain the basic features of astronomical observation, including precession of the equinox and advance of perihelion.	√	√				
• analyze the motion of the Moon, lunar asterisms (Nakshatras), and the dynamics of the Sun and planets within various coordinate systems.	√	√				
• demonstrate practical skills in naked-eye astronomy and effectively use instruments for celestial observation	√	√				