SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Sciences

Physics (Minor)

Syllabus for the Academic Year 2024-2025

based on the National Education Policy 2020

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)
DEPARTMENT OF PHYSICS

COURSE DETAILS FOR MINOR:

	SEMESTER 3		SEMESTER 4
TITLE	**Mathematical Physics, Electricity & Electronics**		**Optics and Digital Electronics**
TYPE OF COURSE - DSC	**Minor**		**Minor**
CREDITS	**4**		**4**

Preamble:

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics. Physics, a Second -Year program, embarks on a journey of discovery through the fundamental principles of physics. Throughout this program, we will explore the diverse and fascinating realms of classical mechanics, optics, thermodynamics, modern physics, and electronics. From the laws of motion to the mysteries of quantum theory, our aim is to cultivate a deep understanding of the natural world and its underlying principles. Through experimentation, analysis, and critical thinking, we will strive to unravel the complexities of the universe and lay the groundwork for further exploration and innovation. Join us as we embark on this exciting intellectual adventure, where curiosity and inquiry are the guiding lights on our path to knowledge and understanding.

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PROGRAMME OBJECTIVES

PO 1	Provide a comprehensive understanding of mathematical physics, electricity, electronics, optics, and digital electronics to prepare students for advanced studies in physics and interdisciplinary fields.
PO 2	Equip students with the ability to apply mathematical techniques to solve complex problems in physics and electronics.
PO 3	Highlight the interconnectedness of mathematical physics, optics, and electronics, preparing students for careers in diverse fields such as quantum mechanics, photonics, and digital technology.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Students will gain proficiency in applying advanced mathematical methods to analyse and solve physical systems, including differential equations, vector calculus, and linear algebra.
PSO 2	Students will acquire knowledge of logic gates, Boolean algebra, and the functioning of digital systems, enabling them to design and analyse digital circuits.
PSO 3	Students will develop the ability to analyze and experiment with optical phenomena, including interference, diffraction, and polarization, along with their applications in modern technologies.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: Sciences **Physics Minor**		**Semester – 3**	
Course Title: Mathematical Physics, Electricity & Electronics		**Course Code: SPHY233MN**	

COURSE OBJECTIVES:

1. Enable students to analyse electrical networks, solve differential equations in physics, and understand the working of electronic devices.
2. Train students in mathematical modelling and analytical problem-solving for systems in physics and electronics.
3. Familiarize students with the behaviour of electrical and electronic components like circuits, resistors, diodes, and transistors.

COURSE OUTCOMES:

The learner will be able to:

1. Students will gain the ability to apply mathematical techniques such as vector calculus, matrices, and differential equations to solve physical problems.
2. Students will understand the functioning of basic electronic components, including diodes, transistors, and their applications in circuits.

Lectures per week (1 Lecture is 60 minutes)		**3**	
Total number of Hours in a Semester		**45**	
Credits		**3**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	**50 marks**

UNIT 1 Mathematical Physics (1 Credit)	1.1	Vector algebra	15 hours
	1.2	Differential equation	
UNIT 2 Alternative current theory (1 Credit)	2.1	AC current theory	15 hours
	2.2	AC Bridges	
UNIT 3 Analog Electronics (1 Credit)	3.1	Oscillators	15 hours
	3.2	Operational Amplifier	

PRACTICAL **Course Title: Mathematical Physics, Electricity & Electronics Practical**	**Course Code: SPHY233MNP**

COURSE OUTCOMES:
The learner will be able to:

1. Students will develop hands-on skills in conducting experiments related to electricity and electronics using modern tools and equipment.
2. Students will learn to analyse electrical circuits using laws such as Ohm's law and Kirchhoff's laws.

Lectures per week (1 Lecture is 120 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	

Sr. No.	Course Content	30 hours
Regular Experiment		
1	Passive low pass filter: To study the frequency response of a passive low-pass filter	
2	Passive high pass filter: To study the frequency response of a passive high-pass filter	
3	Passive band pass filter: To study the frequency response of a passive band-pass filter	
4	Op amp: Inverting amplifier with different gains	
5	Op amp: Non-inverting amplifier with different gains and voltage follower	
6	Op amp: Integrator and Differentiator	
7	Lissajous figures using CRO.	
8	CE amplifier: determination of bandwidth	
9	CE amplifier: variation of gain with load	
10	Frequency of AC mains	
Demo Experiment		
1	Light dependent switch	
2	Charging and discharging of a capacitor	
3	Use of Oscilloscope	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks

II. Semester End Examination (SEE): 50 marks

REFERENCES:

1. Principles of Electronics - V K Mehta & Rohit Mehta (S Chand - Multicolored illustrative edition.
2. Digital Principles and Applications – Malvino, Leach, Saha, McGraw Hill (2013)
3. Charlie Harper, Introduction to Mathematical Physics, 2009 (EEE) PHI Learning Pvt. Ltd.
4. Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – Reprint – 2013)
5. Digital Fundamentals: Thomas Floyd, Pearson (2015)
6. Digital electronics: Fundamental concepts and applications – Christopher Strangio, Pearson Education (1980).

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: Sciences **Physics Minor**		**Semester – 4**	
Course Title: Optics and Digital Electronics		**Course Code: SPHY244MN**	
COURSE OBJECTIVES: 1. To provide a foundational understanding of electrical and electronic principles. To introduce fundamental electronic components like diodes, transistors, and their applications. 2. To explore concepts like Ohm's law, Kirchhoff's laws, AC/DC currents, and power calculations. 3. To study the operation and applications of semiconductors, logic gates, and integrated circuits.			
COURSE OUTCOMES: 1. Students will be able to understand and explain basic concepts of electricity and electronics. 2. They will understand the differences between AC and DC systems and their practical applications. They will be able to calculate power, energy, and efficiency in electrical systems. 3. They will be able to design and analyse simple electronic circuits. They will develop an understanding of the functioning of logic gates and basic digital circuits.			
Lectures per week (1 Lecture is 60 minutes)		**3**	
Total number of Hours in a Semester		**45**	
Credits		**3**	
Evaluation System	**Semester End Examination**	**2 Hours**	**50 marks**
	Internal Assessment	**--**	**50 marks**

UNIT 1 Optics - 1 (1 Credit)	1.1	Concave grating	15 hours
	1.2	Fresnel's diffraction	
UNIT 2 Optics - 2 (1 Credit)	2.1	Polarized light	15 hours
	2.2	Optical instruments	
UNIT 3 Digital Electronics (1 Credit)	3.1	Binary number system	15 hours
	3.2	Logic gates	
	3.3	Flip - flops	

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Programme: Sciences **Physics Minor**	**Semester – 4**
PRACTICAL COURSE: Optics and Digital Electronics Practical	**Course Code: SPHY244MNP**

COURSE OUTCOMES:

The learner will be able to:

1. Students will gain hands-on experience in conducting experiments related to optics and digital electronics, using tools such as lasers, photodetectors, and digital trainers.
2. They will become proficient in using measuring instruments such as multimeters and oscilloscopes.
3. They will develop troubleshooting skills for identifying and resolving issues in practical circuits.

Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**1**	
Evaluation System	**Summative Assessment**	**2 Hours**	**50 marks**
	Continuous Assessment	**--**	

Sr. No	Course Content	
1	R.P. telescope: To determine the resolving power of a telescope.	30 hours
2	R.P. of grating: To determine the resolving power (R.P.) of a diffraction grating.	
3	R. I of prism: To determine the Refractive Index (μ) of the material of a prism using a spectrometer.	
4	Universal gates: To construct AND, OR and NOT gates from IC NAND gate.	
5	Universal gates: To construct AND, OR and NOT gates from IC NOR gate.	
6	Half adder: To design a half adder circuit using basic gates and to verify its truth table.	
7	Full adder: To design a full adder circuit using basic gates and to verify its truth table.	
8	Study of R – S flip flop: To design and verify the flip flop operations using basic and universal gates.	
9	Study of MS-JK flip flop: To design and verify the flip flop operations using basic and universal gates.	

ASSESSMENT DETAILS:

I. Internal Assessment (IA): 50 marks
II. Semester End Examination (SEE): 50 marks

REFERENCES:

1. A Textbook of Optics By: Dr. N. Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (S.Chand, 25th Revised edition2012 Reprint 2013)
2. Optics (5thEdition) by Ajoy Ghatak, Publisher: Chaukhamba Auriyantaliya
3. Digital Principles and Applications by Leach, Malvino, Saha 6th edn.
4. Digital Fundamentals by Thomas L Floyd 10th edn. (Additional Reading)
5. Modern Digital Electronics by R P Jain 4th edn. (Additional Reading