ST. XAVIER'S COLLEGE – MUMBAI
(Est. 1869)
(An Autonomous College affiliated with the University of Mumbai)

Syllabus for Postgraduate Programme as per National Education Policy (NEP-2020)

Programme: MSc in Physics

The academic year 2023–2024

APPROVED SYLLABUS

PRINCIPAL
ST. XAVIER'S COLLEGE
AUTONOMOUS
MUMBAI - 400 001.

ST. XAVIER'S COLLEGE-AUTONOMOUS
MUMBAI-400001

ST. XAVIER'S COLLEGE – MUMBAI
(Est. 1869)
(An Autonomous College affiliated with the University of Mumbai)

Syllabus for Postgraduate Programme as per National Education Policy (NEP-2020)

Programme: MSc in Physics

The academic year 2023–2024

Preamble:
The National Education Policy 2020 (NEP 2020), as put forth by the Ministry of Human Resource Development (MHRD), is anchored in a set of fundamental principles.

These principles serve as the guiding tenets of the education system and encompass the following key elements:

NEP 2020 advocates for a student-centric approach to education, offering a broad spectrum of courses with emphasis placed on outcome-based learning, ensuring a well-rounded education.

Half of the coursework is designed for conceptual and theoretical understanding, with the other half dedicated to practical application through student engagement in activities, apprenticeships, and internships. Pedagogical methods prioritize problem-centered and project-based learning and activities.

NEP 2020 promotes the integration of technology into teaching, learning, and evaluation processes. It also highlights the need to strengthen research pedagogy within each discipline. The policy emphasizes the integration of skilling and employability initiatives into the curriculum and teaching-learning processes. This integration helps to prepare students for real-world employment opportunities.

NEP 2020 supports flexibility within academic programs, allowing students to exit after every year. Credit transfer mechanisms and the accumulation of credits in the Academic Bank of Credits (ABC) provide learners with options to tailor their educational journey according to their needs and aspirations. The overarching goal of NEP 2020 is to achieve equality in education. To do so, it recognizes equity as a process that fosters inclusivity and ensures that all students feel a sense of belonging in the educational system.

The framework of the choice-based credit system
Major Subject: It is the primary area of specialization that a student chooses to focus on during their postgraduate studies. It forms the core of their curriculum, allowing them to delve deeply into a specific field of knowledge and build expertise in that particular subject area.

Elective Course: Students can choose to study from a list of available options, often as part of their PG degree requirements. These courses provide students with the flexibility to select topics that cater to their interests, academic objectives, and career goals.

Research Methodology: In research methodology, students will explore advanced techniques and approaches for conducting rigorous academic research. This comprehensive study will equip them with the skills and knowledge needed to design, implement, and analyze research studies in their respective fields of study.

On-Job Training (OJT)/Internship/Field Project (FP)/Research Project (RP)/Dissertation: These are essential components of experiential learning in higher education. These hands-on

experiences provide students with practical exposure, allowing them to apply theoretical knowledge in real-world contexts, thereby fostering skill development and deepening their understanding of their chosen fields.

Credit Framework

PG Physics Credit Structure for 2023-24 under NEP								
Level	**Sem**	**Major**		**RM**	**OJT, FP,**	**RP**	**Cum Cr/Sem**	**Degree/ Cum Cr**
		Mandatory	**Elective**					
6 (2023-24)	Sem 1	4+4+4+2 =14	4	4	0	0	22	**PG Diploma after TY**
	Sem 2	4+4+4+2 =14	4	0	4	0	22	
	Cum Cr	28	8	4	4	0	44	
6.5 (2024-25)	Sem 3	4+4+4+4 =16	4	0	0	2	22	**PG Degree after TY or after FYUG**
	Sem 4	0	0	0	0	22	22	
	Cum Cr	16	4	0	0	24	44	
88 credits (2 years) after TY or 44 credits (1 year) after FYUGP								

Programme Outcomes aligned to the Vision and Mission of St. Xavier's College (Autonomous), Mumbai (Master's degree programme)

The completion of a two-year post-graduation program at St. Xavier's College equips students with a range of valuable skills and competencies.

1. Disciplinary knowledge and Core competencies/skills:
    - Gain a deep understanding of the subject-related curriculum.
    - Demonstrate advanced skills and knowledge in their academic field of study.
2. Critical and Creative thinking:
    - Reflect critically on acquired knowledge and skills within their core competencies.
    - Generate creative and resourceful ideas to explore new possibilities.
3. Problem-solving and Analytical reasoning:
    - Identify, investigate, and analyze problems effectively.
    - Collect and interpret relevant qualitative or quantitative data.
    - Formulate evidence-based solutions based on their analysis.
4. Research-related skills:
    - Apply research acumen and skills in identifying research issues.
    - Design research studies and interpret the results.
    - Communicate the findings of their studies effectively and accurately.
5. Social Application of Research and Development:
    - Utilize their core competencies and skills to improve social and environmental conditions.
6. Industry-related skills:
    - Acquire skills and techniques relevant to their chosen industry.
    - Demonstrate maturity and professional ethics in managing responsibilities.
7. Ethical and Moral Integrity:
    - Practice values such as honesty, transparency, and accountability.
    - Commit to interpersonal and social ethics.
8. Collaboration, Teamwork, and Multidisciplinary competence:

- Apply their knowledge and mentoring skills in individual, team, or leadership roles.
- Manage ventures in monodisciplinary, interdisciplinary, or multidisciplinary settings.

9. Leadership and Management:
    - Demonstrate effective strategic planning skills.
    - Exhibit efficient organizational and transformational leadership abilities.
10. Social Concern:
    - Show empathy and care for marginalized and disadvantaged individuals.
    - Display respect, compassion, and concern for others.
11. Social and Environmental Well-being:
    - Investigate and design strategies to enhance the well-being of society and the environment.
12. Self-motivation and Lifelong learning:
    - Cultivate a passion for continuous personal and professional growth.

These outcomes reflect the holistic approach taken by St. Xavier's College to develop well-rounded individuals who are equipped to contribute positively to society, exhibit strong leadership qualities, and adapt to the demands of a dynamic world.

Abbreviations:

- OJT: On-job training
- RP: Research Project
- FP: Field Project

List of Courses offered from Semesters I-IV in MSc Physics

Level	Semester	Major Course titles	Elective Course titles	OJT	RP	FP
6.0	Sem I	Mathematical Physics (3+1)	Experimental and Numerical Physics (2+2)	Research Methodology (3+1)	--	--
		Classical Mechanics (3+1)				
		Quantum Mechanics (3+1)				
		Nuclear Physics (2)				
	Sem II	Statistical Mechanics (3+1)	Observational astronomy and the Solar System (3+1)	Internship (4)	--	--
		Electrodynamics (3+1)				
		Atomic and Molecular Physics (3+1)				
		Solid State Physics (2)				
6.5	Sem III	Physics of Radiation and Matter (3+1)	Relativity and Cosmology (3+1)	--	Dissertation -I (2)	--
		Stellar Physics (3+1)				
		Astrophysics of Galaxies (3+1)				
		Interstellar and Intergalactic Medium (3+1)				
	Sem IV	--	--	--	Dissertation -II (22)	--

Composition of the Board of Studies in Physics 2023 – 2024 (as on July 1, 2023)

Sr. No.	Composition	Name
1	Head of the Department & Chairman	Mr. Rajesh Singh
2	Entire faculty of each specialisation	Dr. Ajay Yadav Dr. Rohan Jadhav Dr. Leena Joshi Dr. Radhekrishna Dubey Dr. Amruta Sadhu Mr. Iyappa Raju Faculty, PG section: Dr. Katherine Rawlins Dr. Manojendu Choudhury
3	Two subject experts (other University)	Dr. Raka Dabhade (Fergusson College, SPPU, Pune) Dr. Shirish Pathare (HBCSE, TIFR) Dr. Jyoti Singh (Ajeenkya D Y Patil University, Pune)
4	VC nominee	Dr. Kiran Kolwankar (R J College, Ghatkopar)
5	Representative from industry/corporate sector/allied	Mr. Umesh Singh (Frodel Enterprises, Thane)
6	PG meritorious alumnus	Mr. Sreerag Sundaram (2019 batch)
7	(a) Experts from outside the college (co-opted)	--
	(b) Other members of staff of the same faculty	--

Two-Year Postgraduate Programme in Physics

Year of Implementation	Semester	Course Code	BOS Date	Academic Council Date
2023-2024	**I**	**All courses**	**01/07/2023**	**06/10/2023**
2023-2024	**II**	**All courses**	**01/07/2023**	**06/10/2023**

Programme Specific Outcomes

Sr. no.	On completing MSc Physics, the student will be able to:
PSO 1	Demonstrate competence and apply sound domain knowledge in physics, astronomy and astrophysics in teaching, industry and research.
PSO 2	Use appropriate advanced computer applications, develop algorithms and domain-specific digital tools in the multi-faceted world of IT.
PSO 3	Practice effective academic and creative written and oral communication and presentation skills in physics.
PSO 4	Demonstrate professionalism, organizational skills and employability skills; make decisions, put into practice self-, time- and change-management and solve problems at micro and macro levels.
PSO 5	Enter new research areas within a specific field of physics, astronomy or astrophysics that require analytical and innovative approaches to help ease problems faced by society and to understand the mysteries of the universe.
PSO 6	Understand, investigate and evaluate concepts from diverse disciplines such as physical, biological and social sciences, and relate the course content with environmental problems.