

University of Mumbai



NAAC Accredited “A” Grade (2012) University
University with Potential for Excellence



Department of Physics (Autonomous) (Celebrating 50 Years of Excellence)

Post Graduate Degree Programmes in Physics



Funded under UGC-SAP (DSA-I), DST-FIST (level-I) and DST-PURSE Schemes

Information Brochure

मुंबई विद्यापीठ



प्रतिज्ञा

- ❖ मुंबई विद्यापीठ हे माझे विद्यापीठ आहे आणि या विद्यापीठाचा मी एक सदस्य आहे याचा मला सार्थ अभिमान आहे.
- ❖ या विद्यापीठातील ज्ञानद आणि कार्यात्मक परंपराविषयी मला आदर आणि प्रेम आहे.
- ❖ या विद्यापीठाच्या बहुभाषिक, बहुधर्मीय आणि वैविध्यपूर्ण स्वरूपाचा मला अभिमान आहे.
- ❖ मुंबई विद्यापीठाने रुजविलेल्या आणि जोपासलेल्या आधुनिक विचारप्रणालींचा वाहक होण्याची पात्रता माझ्या अंगी यावी, म्हणून मी सदैव प्रयत्न करेन.
- ❖ या विद्यापीठाचे कुलगुरू, प्र-कुलगुरू आणि कुलसचिव यांच्यासह सर्व गुरूजनांचा व वरिष्ठांचा मी मान ठेवीन. तसेच त्यांचा सुहृद होण्यासाठी मी प्रयत्न करेन.
- ❖ माझे सर्व सहकारी तसेच विद्यार्थी, पालक व इतरेजन यांच्याशी मी सौजन्याने व सहृदयपूर्वक वागेन.
- ❖ भारत देशातील या अतिशय प्रतिष्ठित विद्यापीठाशी मी सदैव निष्ठा राखेन.
- ❖ या विद्यापीठाचा लौकिक वाढविण्यासाठी मी कटिबद्ध आहे.
- ❖ मुंबई विद्यापीठाची शतकोत्तरी प्रतिष्ठा आणि या विद्यापीठाचा भविष्यकाळ उज्ज्वल करण्यासाठी मी सदैव प्रयत्नशील राहीन. यातच माझे सौख्य सामावलेले आहे.

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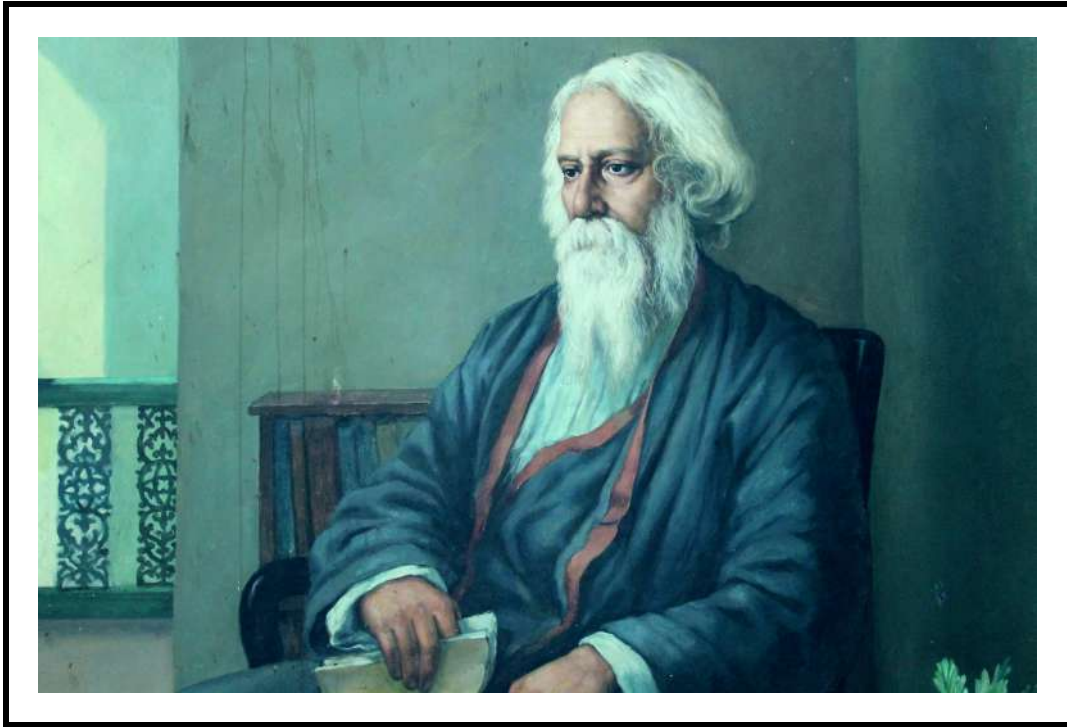
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Website: <https://mu.ac.in/physics>

Department of Physics (Autonomous)



*Where the mind is without fear and the head is held high
Where knowledge is free
Where the world has not been broken up into fragments
By narrow domestic walls
Where words come out from the depth of truth
Where tireless striving stretches its arms towards perfection
Where the clear stream of reason has not lost its way
Into the dreary desert sand of dead habit
Where the mind is led forward by thee
Into ever-widening thought and action
Into that heaven of freedom, my Father, let my country awake*

-Rabindranath Tagore



Prof. Suhas Pednekar
Honourable Vice-Chancellor
University of Mumbai
Mumbai



Late Professor M. C. Joshi
Founder Head of the Department of Physics
(1971-1983)

From the Desk of the Head of the Department



University Department of Physics (UDP), established in 1971, under the dynamic leadership of its founder Head of the Department Late Prof. M.C. Joshi, has grown and emerged, in the last 50 years, as an epitome of academic excellence and knowledge devoted to education, training, research and industrial collaboration.

The department is committed to providing education with the desired academic rigour and to concurrently stimulate the spirit of inquiry, and thirst for knowledge through innovative and contemporary methods in teaching and research. It offers a variety of specialized courses as electives in frontline areas of Physics.

The students graduating from UDP have made a mark in the field of education, research and industry. Many of the recently students are pursuing higher studies and research in institutes of eminence/universities in India and abroad. A large number of students have succeeded in securing gainful employment within the country.

Since 2012, when the University of Mumbai implemented the Credit Based Semester System, the department has adopted an open elective system, in which the student has the freedom to choose 4 elective courses and a two semester project from different specialisations in physics. The electives offered are from a list of 35 specialised courses from Theoretical Physics, Computational Methods in Physics, Materials Science, Astronomy and Astrophysics, Particle Physics, Nuclear Physics, Condensed Matter Physics, Nanoscience and Nanotechnology and Electronics.

The teaching program of UDP has been enriched through involvement of dedicated and outstanding teachers from neighbouring institutes and colleges. In recent years, UDP has also started sharing courses with UM-DAE Center for Excellence in Basic Sciences (CEBS) thus providing a wider choice of electives to both UDP and CEBS students.

The Department has active research groups in the areas of Materials Science, Condensed Matter Physics, High Energy Physics, Astronomy, Space Physics, Nuclear Physics and Computational Physics. The Department of Physics faculty members have research collaborations with eminent institutes and universities in India and abroad and also with other departments within campus. Masters students of UDP get an opportunity to gain from the experience of these active researchers in the department and get a flavour of frontline research during their M Sc project. Many of the students take up experimental projects in neighbouring institutes like BARC, TIFR and SAMEER at IIT Bombay and thus gain wider exposure and experience of working at advanced research facilities in research institutions.

The Department of Physics has always been a source of inspiration to the new generation of students encouraging them to work hard to achieve their cherished goals and to contribute to the society in the best possible manner.

I appreciate your interest in joining UDP and look forward to welcoming you to our community of dedicated faculty, staff and students.

Dr. Anuradha Misra,

Professor and Head

Our Vision

To be a Globally Recognised Centre of Excellence
in
Physics Education and Research

Our Mission

- Continually ignite young minds to boldly and inquisitively explore un-trodden paths
- Establish a world-class academic programme, with dual emphasis on foundational and frontiers teaching and research
- Navigate learners towards the frontiers of Physics
- Instil the spirit of inquiry and innovation
- Create opportunity platforms for nucleation and incubation of entrepreneurs
- Build synergistic channels for productive knowledge transfer and utilisation through industry partners

Our Approach

- Craft a pool of world class human resource in physics
- Establish the best in class infrastructure to facilitate the process of learning and research with the core strengths of the Department
- Nurture experimental, theoretical and computational physics with core strengths in Materials Science, Soft Condensed Matter, Nuclear Physics, High Energy Physics, Astronomy and Space Physics, Atomic Physics and Computational Physics.
- Network with national and global academic institutions through vibrant exchange programs and collaborations in teaching and research
- Involve physics-based industries in academic programmes to enrich the courses and create value-added linkages and career opportunities for faculty and students
- Ensure the creation of responsible personnel through engagement in socially relevant outreach programmes

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Disclaimer:

Every effort has been made to prepare an up-to-date and error-free document. If any typographical or other errors are found, they may be brought to the notice of the Head, Department of Physics. The errors will be corrected by publishing an addendum, if necessary.

1 Introduction

The University of Mumbai is one of the three oldest Universities of India. It is one of the largest universities in the country and has been recognized as a NAAC Accredited “A” Grade (2012) University and as a University with Potential for Excellence by the University Grants Commission in the year 2012.

The Department of Physics, which is one of the most active and vibrant departments on the Kalina Campus, was established in 1971 under the dynamic leadership of its Founder Head of the Department Late Prof. M.C. Joshi who is well known for his pioneering work in the area of ion implantation. Ion implantation based research has continued to be the major thrust area of the Department. However, the Department has established itself as a research center and teaching institution with expertise in all the major areas of Physics under the able guidance of various Heads of the Department.

The Department has been granted autonomy in the year 2013 and continues to be known as the main post graduate centre for Physics in the city of Mumbai by offering a variety of elective courses and project opportunities to the students and by establishing M. Sc. and research labs in several major sub-areas of Physics.

Former Heads of the Department

1. Late Prof. M. C. Joshi 1971-1983
2. Prof. A. A. Rangwala 1983-1993
3. Prof. Ram Pratap 1993-1994
4. Late Prof. S. B. Patel 1994-2000
5. Prof. V. H. Kulkarni 2000-2002
6. Prof. A. M. Narsale 2002-2004
7. Late Prof. T. R. Rao 2004-2005
8. Prof. S. J. Gupta 2005-2007
9. Prof. A. D. Yadav 2007-2010
10. Prof. D. C. Kothari 2010-2013
11. Prof. Anuradha Misra 2013-2016
12. Prof. V. A. Bambole 2016-2019

2 Department Profile

2.1 Faculty Members

1. Dr. Bambole, Vaishali A., Professor



Ph.D. University of Mumbai (ICT, formerly known as UDCT)

Area: Polymer Physics, Electronics, Bio-nano Physics

Research interests: Conducting polymers, electron beam technology, thin films devices.

<https://old.mu.ac.in/wp-content/uploads/2014/04/VAB-Bulleted-CV-.pdf>

2. Mr. Bijewar, Nitinkumar M., Assistant Professor



M.Sc., I.I.T., Bombay

Area: Materials Science, Space Physics

Research interests: Materials science, space physics, cosmic rays, space weather.

3. Dr. Chacko, Sajeev S. , Assistant Professor



Ph.D., University of Pune

Area: Computational Physics, Electronic Structure Theory

Research interests: Computational studies of nanomaterials, electronic structure theory, bio-nano system, molecular interactions.

<http://archive.mu.ac.in/science/physics/sajeev.chacko/index.html>

<https://sites.google.com/site/sajeevchacko/home>

4. Dr. Chakrabarti, Ritwika, UGC Assistant Professor



Ph.D. UGC-DAE Consortium for Scientific Research, University of Calcutta

Area: Nuclear Physics, Nuclear Structure, Gamma Ray Spectroscopy

Research interests: gamma ray spectroscopy, exotic nuclear phenomena away from stability.

https://mu.ac.in/wp-content/uploads/2020/04/Ritwika_Chakrabarti_profile.pdf

5. Mr. Gurada, Chetan, Assistant Professor



M.Sc., M. Phil. University of Mumbai

Research Area: Materials Science and Nano Science

Research interests: Materials Science and nano science.

6. Dr. Hemalatha, M., UGC Assistant Professor



Ph.D., Bhabha Atomic Research Centre, Mumbai

Area: Experimental and Theoretical Nuclear Physics

Research interests: Nuclear Reactions of stable and weakly bound nuclei, Nuclear Structure, Laser Spectroscopy of nuclei away from stability.

https://mu.ac.in/wp-content/uploads/2020/04/Hemalatha_Tandel_profile.pdf

7. Mr. Kasthurirangan, Siddharth, Assistant Professor



M.Sc. University of Mumbai

Area: Atomic Physics

Research interests: Physics of highly charged ions, X-ray spectroscopy. X-ray spectroscopy.

8. Dr. Misra, Anuradha, Professor and Head of Department



Ph.D. I.I.T., Kanpur

Area: Theoretical High Energy Physics

Research interests: Light front field theory, spin physics, resummation in quantum chromodynamics.

https://mu.ac.in/wp-content/uploads/2020/04/A_Misra_Profile.pdf

9. Dr. Nagare, Balasaheb J., Associate Professor



Ph.D. University of Pune

Research Area: Computational Physics, Electronic Structure Theory

Research interests: Computational physics of large molecules, clusters and solid clusters and solids.

https://mu.ac.in/wp-content/uploads/2020/04/balasaheb_j_nagare_profile.pdf

10. Dr. Patel, Nainesh, UGC Assistant Professor



Ph.D. University of Trento, Italy

Area: Material Science, Energy Studies

Research interests: Development of Nano-materials for energy (hydrogen) production and environmental (water) purification.

https://mu.ac.in/wp-content/uploads/2020/04/Nainesh_Patel_profile.pdf

11. Dr. Raghav, Anil N., Assistant Professor



Ph.D., University of Mumbai

Area: Solar-terrestrial Physics, Space Physics, and Cosmic Rays Modulation

Research interests: Dynamic evolution of large-scale magnetic structure in interplanetary space

https://mu.ac.in/wp-content/uploads/2020/04/Anil_raghav_profile.pdf

12. Dr. Rundhe, Milind V., Assistant Professor



Ph.D. Institute of Physics, Bhubaneswar

Area: Experimental Condensed Matter Physics, Material Science

Research interests: Cluster growth and dynamics on a semiconductor surface, interaction of highly charged ions with metals, insulators and semiconductors.

13. Dr. Sarawade, Pradip, Assistant Professor



Ph.D., Hanyang University, South Korea

Area: Material Science

Research interests: Development of nano-porous materials, metal organic framework (MOF), metal nanoparticles for environmental protection.

https://mu.ac.in/wp-content/uploads/2020/04/Pradip_Sarwade_profile.pdf

14. Dr. Srinivasan, Radha, Associate Professor



Ph.D. University of Mumbai (TIFR)

Area: Experimental Condensed Matter Physics, Material Science

Research interests: Nanomaterials for biomedical applications, magnetic materials, magneto-optics, low temperature physics.

https://mu.ac.in/wp-content/uploads/2020/04/Radha_Srinivasan_profile.pdf

Adhoc Faculty

1. Mr. Jitendra Sawant
2. Ms. Sneha Ansurkar

Adjunct Faculty / Honorary Professor / Scientist / Emeritus Fellow (last 5 years)

1. Dr. S. K. Dubey
2. Prof. S. J. Gupta
3. Prof. D. C. Kothari
4. Prof. V. H. Kulkarni
5. Prof. R. K. Manchanda (NASI Fellow)
6. Prof. L. Natarajan
7. Prof. A. A. Rangwala
8. Prof. A. D. Yadav

Post-doctoral fellows / Scientists

1. Dr. Mamta Agarwal, DST Women Scientist

Technical and Research Staff

1. Dr. S. R. Iyer Technical Assistant
2. Dr. T. K. Achal Technical Assistant
3. Dr. V. Jadhav Research Assistant

Administrative, Library, Laboratory and Workshop Staff

Administrative Staff

1. Mr. Harjoram Jaggaram Senior Clerk
2. Ms. Usha Tupe Junior Clerk
3. Mr. R. H. Ghadi Peon
4. Mr. D. R. Khapare Hamal
5. Mr. Kiran Londhe Peon
6. Mr. Ravindra Kudtadkar Peon
7. Mr. Vishal Khadtar Peon

Library Staff

1. Ms. Megha Ghogare Junior Assistant Librarian

Laboratory Staff

1. Mr. V. D. Ghag Lab. Assistant
2. Mr. M. A. Pawar Lab. Attendant
3. Mr. S. K. Chavan Lab. Attendant
4. Mr. Y. C. Raut Lab. Attendant
5. Mr. M. S. Rane Lab. Attendant

Workshop Staff

1. Mr. Nitin Baing Helper

2.2 Research Collaborations

NATIONAL:

- Bhabha Atomic Research Centre (BARC), Mumbai
- Institute of Chemical Technology (ICT), Mumbai
- Institute of Mathematical Sciences (IMSc), Chennai
- Indian Institute of Geomagnetism (IIG), New Mumbai
- Indian Institute of Science (IISc), Bangalore
- Indian Institute of Technology (IITB), Mumbai
- Inter-University Accelerator Center (IUAC), New Delhi
- Materials Science Research Laboratory, Dept. of Physics, J.C.D.A.V College, Dasuya
- Savitribai Phule Pune University, Pune
- Sophisticated Analytical Instrumental Facility (SAIF)- IIT, Bombay
- Tata Institute of Fundamental Research (TIFR), Mumbai
- UGC-DAE-CSR at Indore, Mumbai and Kolkata Centers
- UM-DAE Centre for Excellence in Basic Sciences, Mumbai

INTERNATIONAL:

- GSI Helmholtz Centre for Heavy Ion Research, Germany
- Institut Curie, Centre de Recherche, CRNS UMR 168, Paris Cedex 05, France
- Hanyang University, Seoul , South Korea
- Heliophysics Science Division, NASA/Goddard Space Flight Center, Greenbelt, MD, USA
- King Abdullah University of Science and Technology, Saudi Arabia (KAUST)
- NIKHEF Theory Group, Netherlands
- Russian Academy of Sciences , Russia
- Institut de Physique Nucléaire, Orsay, France
- University of Science and Technology of China, Hefei, Anhui, People's Republic of China
- University of Seoul, South Korea
- University of Trento, Italy
- University of Zagreb, Croatia

2.3 Major Research Facilities

1. Accelerator Mass Spectrometer (AMS)
2. 30 keV Ion Implanter
3. BET surface area analyser
4. Scanning Tunneling Microscope (STM)
5. Vibrating Sample Magnetometer (VSM)
6. Physical Quantities Measurement System (PQMS)
7. Polarization Measurement System (PMS)
8. LASER Lithography Technique
9. Alpha Spectrometer and Scintillation Detector
10. X-Ray Diffractometer with Small angle and glazing angle measurement unit
11. Differential Scanning Calorimeter (DSC)
12. UV-VIS-NIR Spectrometer
13. Fabry-Perot Scattering Set-up
14. Mossbauer Spectroscopy set-up with variable temperature
15. Computational Facility - Servers, Workstations, PCs
16. LX -200, GPS Meade 12' Telescope with ccd
17. Energy Dispersive X-ray Fluorescence Spectroscopy (ED-XRF)
18. Keithley electrometer/ high resistance meter
19. DC and RF Sputtering systems
20. Ellipsometer
21. Thin film vacuum coating system with accessories RTHf
22. Data Thermal Analysis
23. Multiwavelength Refractometer
24. Experimental Kit from Indian Academy of Sciences.
25. Fluorescence Spectrometer
26. FTIR Spectrometer
27. Multi frequency Ultrasonic Interferometer (RT to 200 C)
28. Table Top Ion Accelerator
29. Potentiostat
30. Spin-coating and Dip-coating system

2.4 Major Research Funding

Funding Agency	Year	Amount (Rs. lakhs)
DST-FIST Programme-I	2001-2006	41.5
UGC-SAP-DRS Level I	2003-2009	33.2
DST-Device Grade Nano-materials	2003-2006	62.3
DST-FIST Programme-II	2007-2012	99.0
UGC-SAP-DRS Level II	2009-2014	44.0
UPE Green Technology	2009-2014	—
DST-PURSE Scheme	2014-2019	—
UGC-SAP - DSA Level I	2015-2020	185.0
DST-FIST Programme-II	2016-2021	115.0

3 Academic Programmes: Courses

The Department of Physics, University of Mumbai is the University Department for postgraduate teaching and offers the following programmes:

1. Master's degree programme in Physics (M. Sc. by Papers)
2. Master's degree programme in Physics (M. Sc. by Research)
3. Master of Philosophy in Physics (M. Phil.)
4. Doctor of Philosophy in Physics (Ph.D.)

The following pages contain a brief description of the course structure and syllabi of these programmes.

3.1 M. Sc. in Physics

M.Sc. Program is a two year Master's degree program with a Credit based grading system on a scale of 10.

3.1.1 M.Sc. (by papers) Course Structure and Distribution of Credits

M. Sc. in Physics Program consists of total 16 theory courses, total 6 practical laboratory courses and 2 project courses spread over four semesters. Eleven theory core courses and four practical laboratory courses are common and compulsory to all the students. One theory core course is an option between Experimental Physics and Numerical Techniques & Programming as per the preference of the students. Remaining four theory courses can be chosen from the list of elective courses offered by the department. Two laboratory courses can be chosen from the elective laboratory courses offered by the department every year. The list is updated every year. Each theory course is of 4 credits, each practical laboratory course is of 4 credits and each of the two projects is of 4 credits. A project can be on theoretical physics, experimental physics, applied physics, developmental physics, computational physics or based on industrial product development. A student earns 24 credits per semester and total 96 credits in four semesters. The intake capacity for the course is 68 students per year. The course structure is as follows:

Theory courses

	Paper-1	Paper-2	Paper-3	Paper-4
Semester-I	Mathematical Methods	Classical Mechanics	Quantum Mechanics-I	Advanced Electronics
Semester-II	Numerical Techniques	Nuclear Physics	Quantum Mechanics-II	Solid State Physics
Semester-III	Electrodynamics	Statistical Mechanics	Elective-1	Elective-2
Semester-IV	Atomic and Molecular Physics	Experimental Physics	Elective-3	Elective-4

The elective courses can be chosen from a wide range starting from Nuclear and Particle Physics, Solid State Physics, Solid State Device Physics, Electronics and Communications, Electronics Microprocessor, Microcomputers, Embedded systems, Astronomy, Space Physics, Materials Science, Laser Physics, Plasma Physics and Quantum Field Theory up to other advanced specialized topics. In a given year, only some of the electives will be offered by the department. Every year different electives may be offered depending on the availability of experts.

Laboratory courses

Semester-I	Lab Course-1: General Physics I	Lab Course-2: Electronics and Programming I
Semester-II	Lab Course-3: General Physics II	Lab Course-4: Electronics and Programming II
Semester-III	Project-1	Advanced Physics Lab I / Advanced Electronics Lab I
Semester-IV	Project-2	Advanced Physics Lab II / Advanced Electronics Lab II

Semester I

M.Sc. in Physics Program for Semester-I consists of four theory courses and two laboratory courses. The details are as follows:

Theory courses (4): 16 hours per week including lectures and tutorials

Course Code	Subject	Hours (L+T)	Credits
PSPHC01	Mathematical Methods	60	04
PSPHC02	Classical Mechanics	60	04
PSPHC03	Quantum Mechanics I	60	04
PSPHC04	Advanced Electronics	60	04
Total		240	16

Laboratory courses (2): 16 hours per week including practicals and tutorials

Course Code	Subject	Hours (P)	Credits
PSPHP01	General Physics Lab I	120	04
PSPHP03	Electronics and Programming Lab I	120	04
Total		240	8

Semester II

M.Sc. in Physics Program for Semester-II consists of four theory courses and two laboratory courses. The details are as follows:

Theory courses (4): 16 hours per week including lectures and tutorials

Course Code	Subject	Hours (L+T)	Credits
PSPHC13	Numerical Techniques	60	04
PSPHC06	Nuclear Physics	60	04
PSPHC07	Quantum Mechanics II	60	04
PSPHC08	Solid State Physics	60	04
Total		240	16

Laboratory courses (2): 16 hours per week including practicals and tutorials

Course Code	Subject	Hours (P)	Credits
PSPHP02	General Physics Lab II	120	04
PSPHP04	Electronics and Programming Lab II	120	04
Total		240	8

Semester III

M.Sc. in Physics Program for Semester-III consists of four theory courses, one laboratory course and one project. The details are as follows:

Theory courses (4): 16 hours per week including lectures and tutorials *

Course Code	Subject	Hours (L+T)	Credits
PSPHC05	Electrodynamics	60	04
PSPHC09	Statistical Mechanics	60	04
*	Elective Course	60	04
*	Elective Course	60	04
Total		240	16

Project (1): 8 hours per week

Course Code	Subject	Hours (P)	Credits
PSPHP05	Project I	120	04

Laboratory course (1): 8 hours per week [†] (Any one from the following courses:)

Course Code	Subject	Hours (P)	Credits
PSPHP07	Advanced Physics Lab I	120	04
PSPHP09	Applied Electronics Lab I [‡]	120	04
PSPHP11	Electronic Communication Lab-I [‡]	120	04

Semester IV

M.Sc. in Physics Program for Semester-IV consists of four theory courses, one laboratory course and one project. The details are as follows:

Theory courses (4): 16 hours per week including lectures and tutorials *

Course Code	Subject	Hours (L+T)	Credits
PSPHC10	Atomic and Molecular Physics	60	04
PSPHC12	Experimental Physics	60	04
*	Elective Course	60	04
*	Elective Course	60	04
Total		240	16

Project (1): 8 hours per week

Course Code	Subject	Hours (P)	Credits
PSPHP06	Project II	120	04

Laboratory course (1): 8 hours per week [‡] (Any one from the following courses:)

Course Code	Subject	Hours (P)	Credits
PSPHP08	Advanced Physics Lab II	120	04
PSPHP10	Applied Electronics Lab II [‡]	120	04
PSPHP12	Electronic Communication Lab II [‡]	120	04

*To be chosen from the list of electives announced in Sem III. This list is updated every year.

[†]Applied Electronics and Electronic Communication Labs I and II shall be offered only to those students who choose all four elective courses from electronics specialisation.

List of electives

Students can choose from variety of electives as mentioned below. Final list of elective courses offered in the academic year may vary from year to year.

Courses
Accelerator and Beam Physics
Applied Thermodynamics
Astronomy and Astrophysics
Biomedical Physics and Instrumentation
Computational Methods in Physics
Computer Networking
Crystalline and Non-crystalline solids
Digital Communication Systems and Python Programming
Dynamical Systems
Electronic Structure of Solids
Embedded C, ARM and Interfacing
Energy Studies
Experimental Techniques in Nuclear Physics
Fundamentals of Materials Science
Galactic and Extragalactic Astronomy
Group Theory
Laser Physics
Liquid Crystals
Materials and their applications
Microwave Electronics, Radar and Optical Fiber Communication
Nanoscience and Nanotechnology
Nuclear Reactions
Nuclear Structure
Particle Physics
Physics of Semiconductor Devices
Plasma Physics
Polymer Physics
Properties of Solids
Quantum Computation
Quantum Field Theory
Semiconductor Physics
Semiconductor Technology
Signal Modulation and Transmission Techniques
Surfaces and Thin Films
Thin Film Physics and Techniques
VHDL, C++ and Python Programming
VLSI Design and Embedded Systems

Project Courses PSPHP05 and PSPHP06

The project courses are PSPHP05 and PSPHP06 in semester 3 and 4 respectively.

In the project courses, the student can perform an experimental/theoretical/computational project under supervision of one or more faculty members. In the first part of the project, the student is expected to learn the basics of the topic chosen, learn how to do literature survey and learn and set up the basic experimental /theoretical / computational techniques needed for the project. In the second part, the student addresses the objectives of the project. The second part can also be a reading/learning project if the topic chosen is sufficiently advanced.

The Department encourages projects both in experimental and theoretical areas of Physics, in collaboration with other institutes like UM-DAE CBS, TIFR, BARC, ICT, IIT, SAMEER, IIG or any other institute or industry. In the first two years of its implementation (2013-14 and 2014-15), there were some projects carried out in collaboration with TIFR, BARC and IIG. There were conference presentations and publications in peer reviewed journals that emerged from a few of these projects.

Some of the representative project themes offered by faculty for students are listed below:

Project themes
Path Integral Formulation of QM and QFT
Supersymmetry
Magnetostriction measurement of RFe ₂ alloys
Magneto resistance of Bismuth: Bulk and thin Film
Study of non-linear effects in ferrofluids and other colloids
Synthesis and characterization of some magnetic ceramic compounds of pseudo-brookite series
Tera Hertz Radiation Emission from Ion Implanted GaAs
Paul's Ion Trap for mesoscopic particles
Development of Electro Spray Ion Source with Paul Trap
Study of Multilayer Thin Film Coating Based on CrN and AlN
Dual band GSM mobile Jammer
Android based WiFi video conferencing
Photo rover Robot & ECG Filtering
Gamma-ray spectroscopy using scintillation Detector
Production mechanism of neutron-deficient isotopes of nuclei away from stability
Systematic study of ground state properties of chain of even-even isotopes

Project themes
Hydrogen generation from chemical hydrides using Co-Mo-B. nanocatalyst for fuel-cell
Hydrogen production by sodium borohydride using Co-Cr-B nanocatalyst
Study of hydrogen evolution reaction in water splitting using Co-in-B nanocatalyst
Simple model for dynamic concentration of pollutants over Mumbai region
Study of numerical models for trace gas transport
Catalytic Activities of Nanoparticles
Electronic structure calculations of 2-d quantum spin Hall materials
Thermodynamics of Nanoparticles
Interaction of Bio-nano system
Function Finishing of textile by UV Protection
Conducting Polymer using Plasma Polymerization
Functional Finishing of textile antibacterial
Dyeing of textile (Cotton Fabric) using natural dye
Functional Finishing of textile hydrophilic & hydrophobic
Forbush Decrease: A Case Study
Design and simulation of an x-ray spectrometer for atomic physics experiments
Synthesis of silica aerogels at an ambient pressure and its application

3.1.2 Scheme of Examination and Passing

1. This course will have 40% weightage for Continuous Assessment (CA) and 60% weightage for End Semester Assessment (ESA) for each theory course and 60% weightage for Continuous Assessment (CA) and 40% weightage for End Semester Assessment (ESA) for each laboratory and project courses. All examinations will be conducted by the Department as per the existing norms approved by the examination committee. Mode of continuous assessment will be decided by the teacher concerned for theory courses, and by the lab instructors and in-charge for lab courses.
2. Continuous Assessment (CA) and End Semester Assessment (ESA) shall be treated as a separate heads of passing.
3. To pass, a student has to obtain minimum of 40% marks or above separately in the CA and ESA (written/practical examination/other modes as decided by Examination Committee).
4. The end-semester examination for Theory and Laboratory courses shall be conducted at the end of each Semester and the evaluation of Project work, *i.e.*, dissertation will be held at the end of each semester.
5. The candidates shall appear for examination of 4 theory courses, 2 lab courses (composed of one practical and a project or two practical courses) at the end of each semester. End Semester Assessment will consist of a written examination for theory courses, practical and project examination as per University/Department guidelines.
6. The candidate shall prepare and submit for practical examination a certified Journal based on the practical course with minimum number of experiments as specified in the syllabus.
7. There will be a continuous evaluation of the performance in the laboratory courses throughout the semester and the Continuous Assessment (CA) marks in the laboratory course will be based on this.
8. The student shall carry out the project work for the project course PSPHP05 and PSPHP06 under supervision of a guide from the department or at another institute under joint supervision of a guide from the Department and a co-guide from the concerned institute after taking due permission from the Department. The student shall submit project reports in the prescribed format at the end of semester 3 and semester 4, which will be evaluated by the internal and the external examiners, one of these being the guide.

3.1.3 Standard of Passing for University Examinations

As per ordinances and regulations prescribed by the University for semester based credit and grading system, and examination rules framed by the Examination committee and Subject Board of the Department of Physics.

3.1.4 Standard point scale for grading

1. The following range of marks shall be used to assign grades to the students:

Percentage of marks	Grade
$80 \leq x \leq 100$	O
$70 \leq x < 80$	A+
$60 \leq x < 70$	A
$55 \leq x < 60$	B+
$50 \leq x < 55$	B
$45 \leq x < 50$	C
$40 \leq x < 45$	D
$x < 40$	F

2. The following grade scale will be used for assigning grade points to the students:

Grade	Grade points
O	10.0
A+	9.0
A	8.0
B+	7.0
B	6.0
C	5.0
D	4.0
F	0.0

3. The CGPA of all semesters shall be converted into a Final grade point using the following table:

CGPA	Final Grade
9.50-10.00	O
9.00-9.49	A+
8.00-8.99	A
7.00-7.99	B+
6.00-6.99	B
5.00-5.99	C
4.00-4.99	D
below 4.00	F

3.1.5 Grade Point Average (GPA) calculation

1. GPA is calculated at the end of each semester after grades have been processed and after any grades have been updated or changed. Individual assignments / quizzes / surprise tests / unit tests / tutorials / practicals / project / seminars etc. as prescribed by University are all based on the same criteria as given above. The teacher will convert his/her marking into the Quality-Points and Letter-Grade.
2. Performance of a student in a semester is indicated by a number called Semester Grade Point Average (SGPA). It is the weighted average of the grade points obtained in all the subjects registered by the students during the semester.

$$\text{SGPA} = \frac{\sum_{i=1}^n C_i p_i}{\sum_{i=1}^n C_i}$$

C_i = the number of credits assigned to the i^{th} course of a semester

p_i = the grade point earned in the i^{th} course

$i = 1, 2, \dots, n$ represents the number of courses for which the student is registered in that semester.

The Final grade will be decided on the basis of Cumulative Grade Point Average (CGPA) which is weighted average of the grade points obtained in all the semesters registered by the learner

$$\text{CGPA} = \frac{\sum_{j=1}^N C_j p_j}{\sum_{j=1}^N C_j}$$

C_j = the number of credits assigned to the j^{th} course up to and including the semester for which CGPA is being calculated

p_j = the grade point earned in the j^{th} course

$j = 1, 2, \dots, N$ represents the number of courses for which the student is registered up to and including the semester for which CGPA is being calculated

Note:

The CGPA is rounded upto the two decimal places.

3.2 M. Sc. (by Research) Degree Course in Physics

A candidate for being eligible for admission to the M. Sc. (by Research) in Physics must have passed the Bachelor of Science (B. Sc.) degree examination with Physics as the major subject with minimum higher 2nd Class (CGPA equivalent to grade B+), or an examination of another University recognized as equivalent thereto. The M. Sc. course by research is of minimum two year duration *i.e.* only after completing this period a candidate can submit his / her M.Sc. thesis for evaluation. The student enrolling for M. Sc. by research in the subject of Physics is required to pass separately 8 theory courses from those prescribed for the regular M. Sc. Physics course in a minimum period of three semesters, before he/she can submit his/her thesis for the award of the Master's degree (by Research) in Physics. The total number of credits is 96 distributed over 4 semesters, same as the regular M. Sc. Programme, with at least 32 credits of relevant theory courses [‡]. The structure of the programme is as given below. The final CGPA will be based on the credits accrued in the theory courses and the research work carried out under the guide and the evaluation of the dissertation by a team of examiners, as prescribed by the Academic Board of the Autonomous Department.

The Department generally admits students, depending on the number of vacancies available as. The number of students are as per the university rules and guidelines. The details regarding admission to this programme will be notified on the website, soon after the admission process of the regular course is completed.

Structure of M. Sc. (by Research) programme

Semester 1		Semester 2		Semester 3		Semester 4	
Course	Credit	Course	Credit	Course	Credit	Course	Credit
Mathematical Methods	4	Statistical Mechanics	4	Electro-dynamics	4	Research work [§]	16
Classical Mechanics	4	Elective Course-1	4	Elective Course-2	4	Dissertation	8
Quantum Mechanics	4	Research work [§]	16	Research work [§]	16		
Research Methodology	4						
Research work [§]	8						
Total	24	Total	24	Total	24	Total	24

§

[‡]M.Sc. (by Research) program is subject to approval by Academic Council.

[§]Towards Dissertation.

3.3 M. Phil. Degree Course in Physics

The M.Phil Degree programme in Physics is a 1½ years full time course consisting of course work of one year duration and dissertation work of six month duration. The course work will consist of two core courses of 6 credits each in I Semester, one survey of Practical/Theoretical course or dissertation with 6 credit in I semester and two elective papers with 6 credits each and dissertation with 6 credits in II semester. The third semester will have only dissertation with 18 credits. The Department generally admits students, depending on the number of vacancies available as. The number of students are as per the university rules and guidelines. Brief description of M. Phil. syllabus and distribution of topics is shown below.

M. Phil. Part I, Semester - I

	Paper	Max. marks	Min. marks	Contact hrs	Credits
1	Research Methodology	100	50	60	6
2	Experimental Methods / Theoretical Physics	100	50	60	6
3	Survey of Practical / Theoretical Course OR M. Phil Dissertation by Research – Part I	100	50	60	6
	TOTAL	300	150	180	18

M. Phil. Part I, Semester – II

	Paper	Max. marks	Min. marks	Contact hrs	Credits
1	Semiconductor Physics	100	50	60	6
2	Modern Electronics	100	50	60	6
3	Nanotechnology	100	50	60	6
4	Accelerator Physics	100	50	60	6
5	Nuclear Physics	100	50	60	6
6	Laser and Plasma Physics	100	50	60	6
7	Materials Science	100	50	60	6
8	Condensed Matter Physics	100	50	60	6
9	Advanced Quantum Mechanics and Quantum Field Theory	100	50	60	6
10	M. Phil Dissertation by Research - Part II	100	50	60	6
	TOTAL	300	150	180	18

Note: Any two modules from the available modules offered (the number of modules offered can vary from year to year)

M. Phil. Part II, Semester - III

	Paper	Max. marks	Min. marks	Contact hrs	Credits
1	M. Phil Dissertation by Research - Part III	300	150	180	18

Semester-wise summary of credits:

S. No.	Semester	Theory	Research/Survey	Total
1	I	12	6	18
2	II	12	6	18
3	III	-	18	18
Total		24	30	54

3.4 Ph. D. Degree course in Physics

A candidate for being eligible for admission to the Ph. D. Degree in Physics must have passed the Master of Science (M. Sc.) / M. Phil degree examination with Physics. Generally, applications are invited twice in an academic year. The candidates should have a B+ grade or equivalent in M. Sc. and should have cleared University PET/ NET/ SET examination or equivalent National level examination.

Short listed candidates are called for an interview clearing which they are admitted to the Ph. D. program.

Each learner after having been admitted to the Ph. D. degree programme, shall be required to undertake course work for a minimum period of one semester. The course work shall be treated as pre-Ph. D. preparation.

The Ph. D. course work shall be offered with credit system. The entire course work will have total 18 credits. The learner will have to earn 18 credits before synopsis submission.

The candidates with an M. Phil degree shall be exempted from course work. After selection, the candidate pursues research in frontline areas of Physics. The research programme in the department is being carried out in the following areas:

A. Experimental Physics

Ion implantation, Ion Beam Mixing	Nano structuring by Swift Heavy Ions
Elastic Recoil Detection Analysis	Recrystallization
Semiconductor Devices	SIMOX /SIMNI, Thin Films
Photovoltaics	Magnetism
Dilute Magnetic Semiconductors	Nanomaterials and Nanotechnology
Bio-nano materials	Surface Physics
Liquid Crystals	Crystal Growth
Nuclear Reactions and Nuclear Structure	Polymer Physics
Energy Studies and Environment	Catalysts and Photocatalysts

B. Theoretical Physics

Condensed Matter Physics	High Energy Physics
Modeling and Simulation of Materials	Ion Atom Collisions
Dusty Plasma	Quantum Field Theory
Quantum Chromodynamics	

4 Facilities in the University Department

4.1 M. Sc. Laboratories

M. Sc. laboratories of the Department of Physics, University of Mumbai are well equipped to carry out experiments in Electronics, Solid State Electronics, Solid State Physics, Nuclear Physics, Laser and Plasma Physics, Liquid Crystals, Astronomy and Space Physics, Electronic Communications and Microprocessors & Microcomputers.

In Microprocessor lab, students are encouraged to study the 8051 Microcontroller - Programming & Assembly and hand coding on the 8085 microprocessor kits. They are also exposed to numerical methods by programming and by writing algorithms on PCs. In Electronic telecommunication lab, students are exposed to the Fiber Optic, Microwave, PC to PC communication experiments. As a part of their curriculum, they do projects which involve designing, fabrication and testing of new circuits. In Solid State Electronics lab, students are encouraged to fabricate simple devices such as Schottky barrier diodes, MOS etc. and characterize them. High temperature furnace required for oxidation of Si and doping of impurities, vacuum thin film units, Electron beam gun, D.C. Sputtering are available for device fabrication. Structural characterization is carried out in Solid State Physics lab. X-ray diffractometer and Fourier transform infra-red spectrometer are the major facilities available to students. In Materials science lab, synthesis and characterization of materials is emphasized. In Nuclear Physics laboratory students perform experiments using alpha and gamma-ray spectroscopy. Na(Tl) Scintillation and gas filled detectors are some of the radiation detectors. In Liquid Crystal Lab, students study R.I. and dispersive power of material using Abbeys Refractometer. The Department has recently procured the 12' Telescope (Meade Autostar II) and some night-sky observations have been carried out.

The Department has been associated with IUCAA, Pune for experiments on Observational Astronomy where the students spend 4-5 days in mid February on IUCAA campus performing the experiments under the guidance of IUCAA faculty members.

4.1.1 Facilities



Electronics Workstation



Michelson Interferrometer



X-Ray Apparatus



Ellipsometer



Solar Cell

4.2 Research Laboratories

Major experimental research facility is in the field of ion beam modification of materials. The Department has a high-current ion implanter, which is one of the few implanters of its kind. It can provide mass analyzed ion beams of energy 30 keV of any species ranging from hydrogen to uranium. Major application of such a beam is to produce novel phases having exotic properties in the near surface region of any material. The Department has several sophisticated instruments *e.g.* X-Ray Diffractometer, Ultraviolet-Vis-NIR spectrometer, Metallurgical Microscope, Fourier Transform Infrared Spectrometer Differential Scanning Calorimeter, with image analyzer, Mossbauer spectrometer, XRF spectrometer, Low Energy Electron Diffraction, High Vacuum Plasma Discharge system, Czochralski crystal growth system, Thermal Evaporation, d.c sputtering systems, Electron gun evaporation, Four point probe resistivity set-up, Polarization microscope, I-V and C-V setup to name the major facilities. Thin films, plasma physics, condensed matter physics, surface physics, solid-state device physics are some of the areas in which active experimental research is being carried out in the Department. In the liquid crystal research Lab, students can learn the use of spectroscopic techniques to study the opto-electronical properties and physico-chemical reactions. These studies will be useful in the future for exploring various possibilities of using CLC and mixtures with Nano-powder, elastomers, micro-fluids, quantum dots for diverse applications like Smart windows, detection of blockages in blood flow, detection of bubbles in coating of metal sheets, etc.

The department faculty members have active collaborations with faculty members of the National Centre for Nanoscience and Nanotechnology, which is also situated in the

Vidyanagari campus. The highly sophisticated experimental facilities at the Nano-Centre are expected to be operational soon, and shall be accessible to all members of the Department of Physics.

The Department also has a Theoretical Physics group actively engaged in research in frontline areas in nonlinear phenomena including nonlinear optics, laser physics, space plasma physics and particle physics.

The Department is also a major user of UGC sponsored National Facility - Pelletron Heavy Ion Accelerator at the Inter-University Accelerator Center (formerly the Nuclear Science Centre), New Delhi. Research programmes are actively pursued in the fields of Nuclear Reactions and Structure.

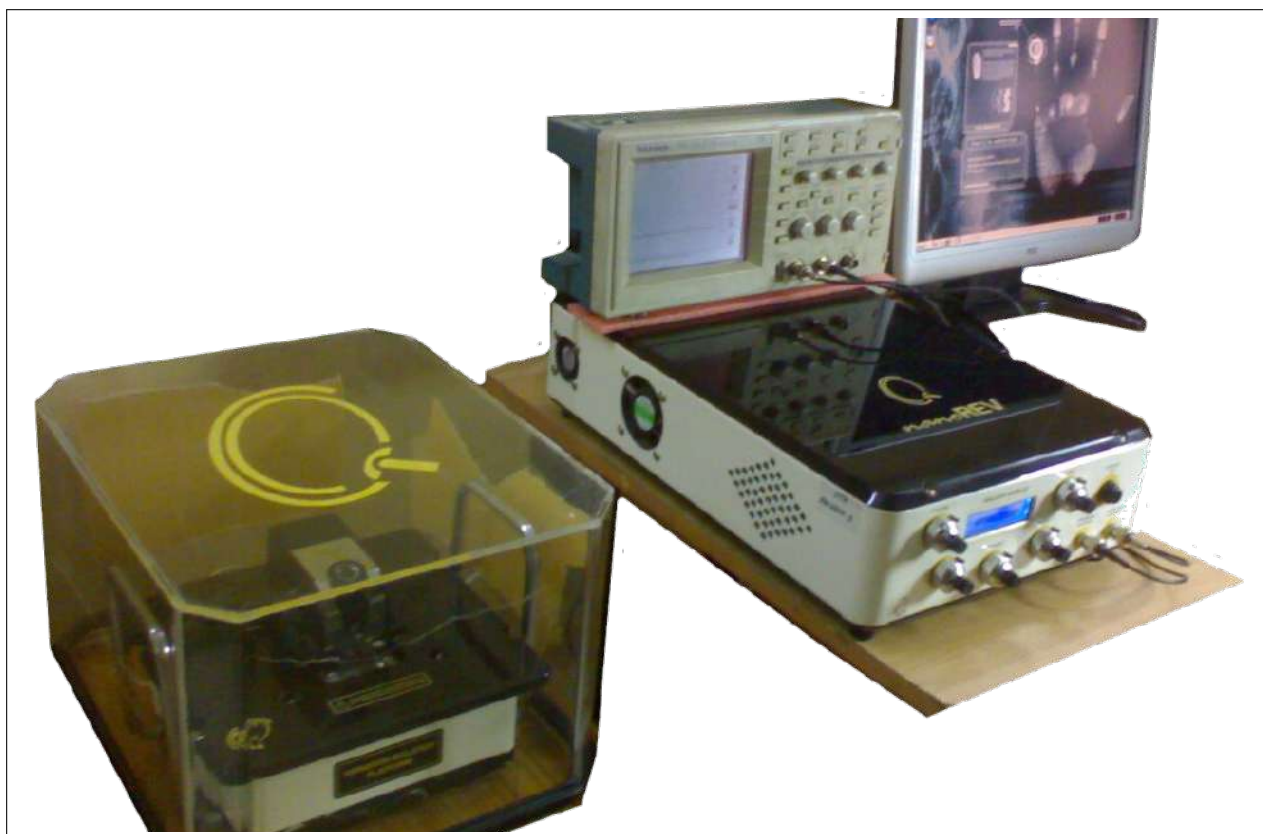
4.2.1 Laboratories

Molecular Electronics Laboratory

The laboratory is equipped with different instruments like four and two probe conductivity set up conceptualized and indigenously fabricated to measure conductivity of ultra-thin films. The gas sensor set up is a novel instrument for gas sensing. The design of sensor head is unique and novel and accommodates up to 20 sensors. The sensor head set-up is integrated with a data acquisition system and is sensitive to ppm level of gas as well as selective to a particular gas. Plasma enhanced chemical vapour deposition system is low cost system with a unique facility of generating pulsating Plasma. Due to which ultra-thin (tailor made to thickness and size) of conducting polymers can be synthesis which can be used as electrodes for super capacitor. Electrospinning set-up for fabricating nanofibres is designed to synthesize ‘Nanofibres’ of conducting polymers for making Polymer Nanocomposites. Excellent nanofibres can be synthesized which form the seed of “Tissue Engineering”.



Physical Quantity Measurement System (PQMS)



Scanning Tunneling Microscope (STM)



Electrospinning system

Bio-Nano Physics Laboratory

The laboratory is fully equipped for doing bio nano research. It is a well equipped center for food technology research also. The instruments procured in the laboratory is of high quality and standard. The laminar airflow allow the researcher for doing microbial analysis with out any external contamination. The deep freezer and incubator provides sufficient environment to keep the analysis intact. Lab is equipped for doing various characterizations. Protein estimation can be done with the Kjeldal apparatus. Like that muffle furnace, hot air oven and bacterial counter provides the suitable instruments for characterization. A high quality autoclave machine is there. The centrifuge and stomacher instruments provides the add on facility for testing. The ambience and facility inside the laboratory is par with international facility.



Bio-Nano Laboratory

Proposed Advanced Nuclear Physics Laboratory

The Nuclear Physics Laboratory was initially set up by Prof. M.C. Joshi who was the Founder Head of Department of Physics. It is now being upgraded and a new Advanced Nuclear Physics (ANP) laboratory is being set up with innovative and open-ended experiments. A few detectors for measuring gamma rays and alpha particles along with some signal processing electronics are available in laboratory. The experiments are interfaced to computers to enable data collection and subsequent analysis. New detectors and instrumentation to perform high resolution spectroscopy are being planned. The ANP laboratory Course would include experiments with variety of detectors and instrumentation.



Proposed Advanced Nuclear Physics Laboratory

Liquid Crystal and Chemical Synthesis Laboratory

Our research aims to synthesize shape and size controlled metal and metal oxide nanocatalyst which will be used to produce hydrogen and oxygen gas by splitting water under the appropriate electrochemical conditions. Our main goal to synthesize nanomaterials with various morphology using a facile solvothermal synthesis process. Prepared nanomaterials with specific size and shape for energy and environmental related applications, such as CO₂ capture from air in order to reduce the increasing pollution, water purification, Hydrogen and Oxygen production from water by water splitting process.

Our research group also focuses on synthesis of extremely porous nanoporous silica and carbon (Silica & carbon aerogel) with specific pore size, pore volume and surface area and their application for environmental related problems.



Polarising Microscope

Proposed Astro, Space, Atmospheric Physics Laboratory

The Astro, Space, Atmospheric Physics (ASAP) group investigates the dynamic evolution of large-scale magnetic structure in interplanetary space, their interactions, the energy exchange processes involved therein, their geo-effectiveness, and their effect on cosmic ray modulation. These studies are executed using various spacecraft (*e.g.* ACE, WIND, Helios 1 and 2, IMP 8, GOES etc.) and ground base (an *e.g.* Worldwide network of Neutron monitors and muon monitors) archival data. For carrying out such work to a fuller extent an ASAP laboratory has been proposed. We have already procured a few computers to carry out these calculations. Besides this, we have also procured a 12" Mead telescope (Manual) and its accessories. Moreover, the ASAP group has been earmarked adequate funding through UGC-SAP (Rs. 55 lacs) for procuring various other equipment. The work of ASAP group is recognized by the international scientific community. There have been 8 international publications in the last two years alone, including a large number entirely from the work of

M.Sc. Students.

Surface Physics Laboratory

The Surface Physics Laboratory derives its name from the low-energy electron diffraction (LEED) setup which is the central experimental setup in the lab. The LEED has been used extensively in the past for surface structure determination studies, and several Ph. D. scholars of the Department have utilised this facility. With the induction of active researchers in the field of Atomic Physics in 2014, a plan has been evolved to modify the existing setup for atomic and molecular physics experiments, while retaining the original functionality. Other facilities in this laboratory include a set of 4 computers, used with dual purpose - (a) analysis of experimental data generated collaboratively with TIFR (Prof. Lokesh Tribedi: Accelerator-Based Atomic Physics group), (b) theoretical calculations of atomic structure and spectra using state-of-the-art atomic structure codes such as GRASP2K, RATIP and FAC, for comparison with laboratory and astrophysical data.

Material Science and Ion Implanter Laboratory

Well organized chemical synthesis laboratory has been set-up in this laboratory which contains magnetic stirrers, sonicators, centrifuge machines, double distilled water plant, muffle furnaces, fume-hood, milling, spin-coater and dip-coater. All these equipment are used to synthesize catalyst, photocatalyst, magnetic, optical etc. materials for different applications. The major research works that are conducted are as follows:

1. Nano-catalyst synthesis based on transition metals for production of H₂ as a clean energy using water splitting and hydrolysis of chemical hydrides.
2. Development of photocatalyst nanomaterials for photocatalytic water splitting and for degradation of organic water pollutants using solar energy.
3. Magnetic materials such as various spinel ferrites are fabricated in this laboratory for application towards spintronic.
4. Interaction of biomolecules, like protein & DNA, with inorganic nanoparticles is also studied in this lab.

RF-sputtering, DC-sputtering and thermal vapor deposition are also established in this laboratory for fabricating solid-state thin films of metal and metal oxide on various substrates. This laboratory also accommodate 30 KeV Ion Implanter facility but it is currently under repair and maintenance and no active research is been persuaded. This Lab is used by all faculties and students working in the field of Material Science and Nanomaterial synthesis.

In this laboratory X-Ray Diffraction (XRD) and X-Ray Fluorescence (XRF) facilities have also been installed. These are common facilities used by all students and faculties of the department working in the field of Material Science. XRD is used to investigate the structural properties of the material in form of powders as well as thin films. XRF provides the elemental composition of the materials.



Ion Implanter Laboratory



Semiconductor and Thin Film Laboratory



Hydrolysis setup



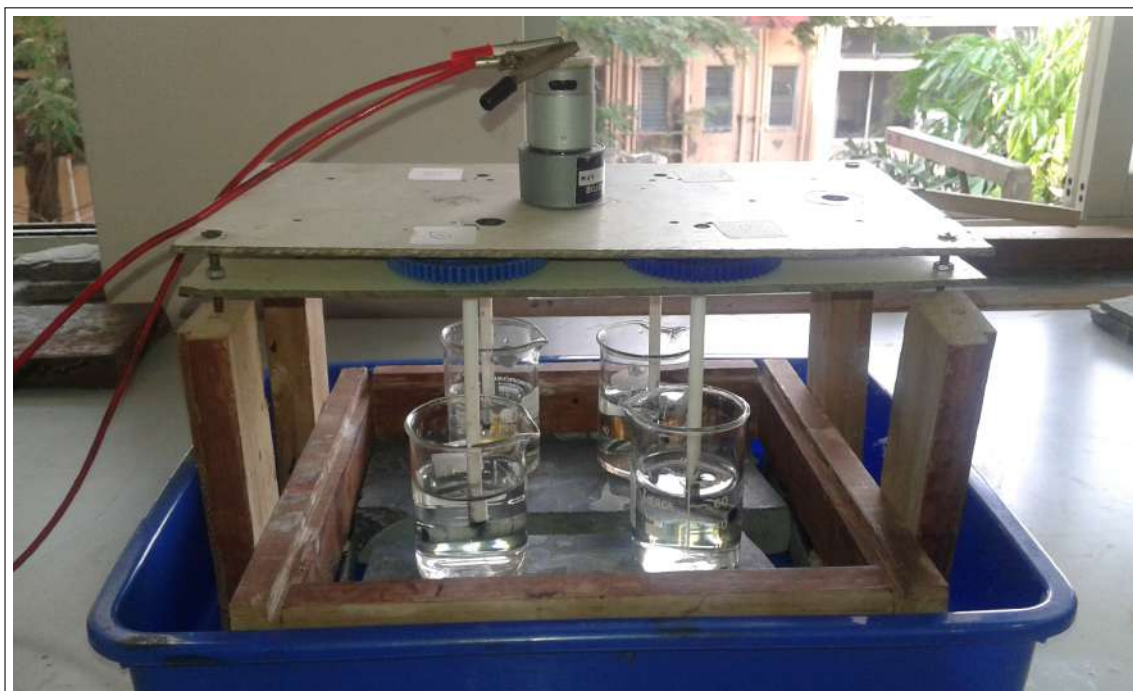
X-Ray Diffraction System (XRD)



Photo Reactor



Magnetoresistance and Hall Effect System



Indigenously developed in-house magnetic stirrer

4.2.2 Facilities

Accelerator Mass Spectrometer Facility

The 1 MV Accelerator Mass Spectrometer (AMS) facility funded by DAE-BRNS will satisfy a vital experimental need in the field of archaeology, to quantitatively explore and understand our past with unprecedented detail. It is a dream facility for Indian Archaeology community for precisely dating historic artefacts. The AMS can date any historical object as old as 60,000 years, with a precision of 50 years. The quantity required for dating is minute, as small as 0.5 mg of graphitized sample. This is the third such machine for carbon dating in India. AMS relies on high sensitivity measurements of isotopes of different elements.



Accelerator Mass Spectrometer (AMS)

4.3 Computing and Internet Facilities

Computers are extensively used in the M.Sc. labs, where the students are taught about numerical techniques, interfacing and computer programming. At the research level, students become familiar with the sophisticated software packages and learn how to adopt them for the research problems of interest. A separate computer laboratory for students is in the process of being setup under the DST-FIST programme. A free WIFI network facility is also available.

4.4 Departmental Library

The Department has also refurbished its own Library and can lend books to students, as well as allow them to use the reading room facility. The Department library complements the main library with an excellent collection of classic Physics treatises and the latest books and monographs on emerging fields. The library is being equipped with all the reference books and other reference material needed for ready reference of department students.



Departmental Library

5 Admissions

The procedure for enrolment of candidates to the M.Sc. Physics course (by papers) is as follows:

1. The Department shall admit students only for University Department of Physics (UDP) (Autonomous). The selection of candidates would be strictly on merit basis within each category.
2. The application form for admission to the course and information brochure can be had from the office of the Department of Physics, University of Mumbai, Vidyanagari Campus, Santacruz (East), Mumbai - 400 098. While filling up the application form for admission, every student should go through the brochure carefully and fill up the application form for admission according to the instructions mentioned therein.
3. The Computer Data Entry Form has to be filled online only. The link to this form is:

<https://t.ly/Oa8u>

Once the form is filled online and submitted, a copy of the same will be generated and sent to the candidate's valid e-mail ID.

4. All marks (paper-wise as well as total) must be entered without considering any grace marks/additional marks awarded in the total or in any individual paper.
5. The application forms duly filled-in and signed and accompanied by the originals as well as certified copies of statement of marks, caste certificate and caste validity certificate should be submitted to the staff-in-charge of the admissions during the period specified for the purpose on the notice board in the Department. In case of DT-A (V.J), NT-B, NT-C, NT-D, OBC and SBC reserved category candidates the non- creamy layer certificates of the current financial year is also required. **Incomplete applications without mark sheet, caste certificate issued by competent authority will be rejected.**
6. For the students from University of Mumbai, only the marks obtained by the candidate in Physics (no Applied Component) in the third year B.Sc. Vth and VIth semesters examinations of the University will be considered for deciding merit for admission to the M.Sc. course in Physics. Thus the merit list will be prepared based on the third year B.Sc. marks in Physics only. There will be a reduction of 3% of the marks for those candidates who have passed the examination at the second attempt.
7. No individual intimation will be sent to candidates selected for admission including those who are from other Universities. The list of students selected for admission to the course will be put up on the notice board of the Department. Generally three such admission lists based on merit are displayed one after the other in a short interval of time.
8. 3% seats are reserved for students coming from other Universities.
 - (a) For applicants from Universities other than University of Mumbai there will be a reduction of 10% of marks while preparing merit list.

- (b) A candidate belonging to University other than the University of Mumbai should have Physics as one of the major subjects at the third year of the B.Sc degree course. For the purpose of calculating the percentage for admission of such a candidate only the marks obtained in the subject of Physics in all the three years of B.Sc. will be taken into account.
- (c) Such candidates are required to produce the original mark sheets of all the three years along with their applications form duly filled in and signed and accompanied by certified copies of mark sheets of all the three years indicating clearly the marks obtained, along with the maximum marks in the subject of Physics each year. An application without this information will be considered incomplete and rejected.
- (d) Applicants from other Universities are required to submit a provisional certificate of eligibility while enrolling for the course. This provisional eligibility certificate can be obtained from the Registrar, Eligibility Section of University of Mumbai, Vidyanagari, Mumbai- 400 098 after submitting the application and necessary remittance.
9. The reservation for physically handicapped (PH) candidates is 03%.
The reservation for Defence / CG, SG Transfer / Widow / Sports is 03%.
The candidate should mention his/her category in the Application.

10. The quotas for reservation ¶ in admission in the course prescribed for different categories are:

1	Scheduled Caste and Scheduled Caste-converts to Buddhism	(SC)	13%
2	Scheduled Tribes	(ST)	07%
3	Vimukta Jaati	(VJ/DT-A)**	03%
4	Nomadic Tribes (NT)	(NT-B)**	2.5%
5	Nomadic Tribes (NT)	(NT-C)**	3.5%
6	Nomadic Tribes (NT)	(NT-D)**	02%
7	Other Backward Classes	OBC**	17%
8	Special Backward Classes	SBC**	02%

** Non-creamy layer certificate of current financial year is compulsory.

N.B: The reserved quota is applicable only for Mumbai University Graduates and for graduates from other Universities within Maharashtra.

11. **IMPORTANT:** The applicants should keep the following certificates ready as soon as possible and submit along with the application:
- (a) B. Sc. Original Mark-sheet and one attested copy.
- (b) Caste Certificate Original and one attested copy (for reserved category students).
- (c) Non-creamy Layer Certificate Original and one attested copy (for reserved category students).
- (d) Gap Certificate (Affidavit: If a student had a gap in studies after B. Sc. course)
12. A candidate selected for admission to the M. Sc. Part I Physics course will have to pay the fees for registration as a post-graduate student, as notified in the list of selected candidates put up on the notice board of the Department. The fee will have to be paid on or before the last date mentioned in the list, failing which the candidate will forfeit his/her claim to the seat allotted in the list.

¶May change as per latest Government/University rules.

13. A candidate who fails to avail of the admission offered to him/her before the last date as mentioned in the first list of selected candidates will not be considered for a seat in the second or subsequent list.
14. The vacancies that may arise on account of the selected candidates not availing themselves of the admission before the last date or those who might withdraw their admission will be notified through subsequent announcements in the Department and students would be chosen from the merit-based waiting list.

If many seats remain unfilled after the first round, a second round of admissions will be announced and held shortly thereafter, wherein vacant seats in a specific merit list will be filled on basis of merit from the respective lists. If few seats remain unfilled, the vacant seats will be filled during spot admissions in a final round.

15. The candidates so selected for admission will have to pay the registration fee on or before the date indicated to them while admission is granted, failing which they will forfeit claim of admission to the course and the same will be offered to the next deserving candidate on the merit-based waiting list.

6 Fees

Details of the Yearly Fees for the M.Sc. course (all subjects, aided) as per the Circular no. UG/386/ of 2009, dated 6th October, 2009 of University of Mumbai are given below. Form and prospectus fees will be collected at the time of the purchase of prospectus. In addition, Railway concession fee, Cultural activity fee and library smart card fee will be collected at the time of admission for students taking admission in University Department of Physics, as prescribed by the University. Any additional applicable fees may be charged by University Department of Physics on recommendation of the Examination Committee/Management Board.

Note: The Fees may be upwardly revised by the University/Department and the revised Fees applicable at the time of admission will be charged.

	Open	Reserved
Fee	Amount (Rs.)	Amount (Rs.)
Tuition	1,000/-	-
Other fees/Extracurricular activities	250/-	-
Registration fee for M Sc Part I only	850/-	-
Registration form fee	25/-	-
Laboratory fee	6000/-	-
Laboratory deposit	400/-	-
Library	1080/-	-
Gymkhana	200/-	-
Admission processing fee	200/-	200/-
Vice chancellor's fund	20/-	20/-
Magazine	100/-	-
Identity card	70/-	50/-
Group insurance	40/-	40/-
Student welfare	50/-	50/-
University sports	30/-	-
Development fee	500/-	/-
Utility	250/-	-
Computer/internet	500/-	-
e suvidha	50/-	50/-
e charges	20/-	-
Disaster relief fund	10/-	10/-
Cultural Activity	6/-	
Total	11,651/-	420/-

Document verification (wherever applicable)	400/-
Form and Prospectus fee	100/-
University Exam fee	600/-
Mark sheet	50/-
Project fee(wherever applicable)	2000/-
Convocation fee only for M Sc part II	250/-
Refundable deposits:	
Caution money	150/-
Library deposit	250/-

NB: Foreign students will have to pay five times of prescribed fees.

7 Attendance Rules

The attention of students seeking admission to M. Sc. degree course is particularly invited to the following rules relating to the postgraduate studies.

1. For granting the permission to take final examination, in each subject minimum attendance of 75% both in theory lectures and practicals/tutorials is compulsory.
2. The students will be required to attend in each semester not less 75% of the total number of theory lectures delivered and also not less than 75% of the lectures delivered in each paper.
3. In addition to attendance at lectures and practicals, they will be required to carry out regularly the work assigned to them in the form of home assignments, problems, tutorials, etc. They shall be required to maintain a record in a properly bound journal. The work carried out by them shall be reviewed by respective teachers both during the semester and at the end of the semester.
4. The work that will be carried out by them in the form of experiments, tutorials etc., shall be in addition to the practical work that they are required to do for the examination.

8 Opportunities after M. Sc. (Physics)

Major exams conducted for Physics students in India

- For admission in PhD programme of Mumbai University
PET Exam (conducted in February and July)
- For PhD entrance: General exams for admission to various national institutes
 1. CSIR/UGC NET
 2. GATE
 3. JEST (for PhD in 16 institutions around India)
- Entrance Exams for the specific Institutes
 1. Tata Institute of Fundamental Research (TIFR) graduate studies exam
 2. Indian Institute of Astrophysics (IIA) entrance exam
 3. Inter University Centre for Astronomy and Astrophysics (IUCAA) entrance exam
 4. Satyendra Nath Bose National Centre for Basic Sciences (SNBNCBS) exam
 5. Bhabha Atomic Research Centre (BARC) JRF exam
 6. Indira Gandhi Centre for Atomic Research (IGCAR) JRF exam
 7. Physical Research Laboratory (PRL) JRF exam
 8. Indian Institute of Geomagnetism (IIG) exam
 9. Aryabhata Research Institute of Observational Sciences (ARIES) exam
 10. Harishchandra Research Institute (HRI) exam
 11. Saha Institute of Nuclear Physics (SINP) exam
 12. Centre for Liquid Crystal Research (CLCR) exam
 13. Indian Neutrino Observatory (INO) exam
 14. IUCAA National Centre for Radio Astronomy (IUCAA-NCRA) Admission Test (INAT)
 15. Centre for Nanosciences & Nanotechnology, University of Mumbai

For further studies abroad

1. GRE (Graduate Record Exam)
2. TOEFL (Test of English as a foreign language)
3. IELTS (International English language testing system)

Job opportunities

1. Bhabha Atomic Research Centre (BARC) Training School Exam
2. Defence Research and Development Organization (DRDO) SET (Scientist Entry Test)
3. Institute of Plasma Research (IPR) training programme

4. Indian Space Research Organization (ISRO)
5. Air traffic controller
6. Combined Defence Services Examination (CDSE) (Age limit 25)
7. Oil and Natural Gas Company (ONGC)
8. Medical Physicist at Tata Memorial Hospital (TMH)

Training programmes

ConCEPTS

Competitive exams like NET, SET GATE, JEST, etc., are stepping stone for M.Sc. students to define their career paths in research or teaching positions. The Department of Physics, University of Mumbai, Mumbai in collaboration with INYAS-Mumbai, have started a pilot program for M. Sc. students 0 Continuous **Continuous Competitive Exam in Physics Test Series (ConCEPTS)**. Through this program students are given a few problems solving and time management methods in each of the subtopics by expert resource persons followed by online assessment.

All the lectures in this series can be viewed on our ConCEPTS YouTube channel <https://www.youtube.com/channel/UCW1612ieVB736hotezlilWQ>

Summer training programmes

1. Science Academies' Summer Student Program
2. Indian Institute of Astronomy (IIA)
3. Indian Institute of Science (IISc)
4. Physical Research Laboratory (PRL)
5. Institute of Plasma Research (IPR)
6. Indian Institute of Technology (IITs)
7. Indian Administrative Service (IAS)
8. Harishchandra Research Institute (HRI)
9. Raja Ramanna Centre for Advanced Technology (RRCAT)
10. Raman Research Institute (RRI)
11. Tata Institute of Fundamental Research (TIFR)
12. Inter University Centre for Astronomy and Astrophysics (IUCAA)
13. Institue of Mathematical Science (IMSc)
14. Aryabhata Research Institute of Observational Sciences (ARIES)
15. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)

16. The Centre for Nanosciences and Nanotechnology (CNNUM)
17. Indira Gandhi Centre for Atomic Research (IGCAR)
18. Saha Institute of Nuclear Physics (SINP)

Winter training programmes

1. (PRT-PLANEX)
2. Indian Institute of Science (IISc)

9 Alumni

Golden Year Alumni Network

The University Department of Physics, known as UDP, was established in 1971 on Kalina Campus of the University of Mumbai. Over the past 49 years, the alumni of UDP have excelled in various fields including teaching and research in Physics and related areas, industries and business, science education, science popularization and outreach, scientific writing and social service.

The Golden Year Alumni Network (GYAN) is an initiative, in the Golden Jubilee year, to bring together the past, present and future of the department through engagement with alumni and Post teachers. Through GYAN lecture series alumni, former teachers and eminent personalities associated with the department shares with the younger generation their journeys beyond UDP as well as the exciting work they are engaged in, thus providing a glimpse of possibilities and opportunities awaiting the young minds.

The lectures series was inaugurated started at the end of July 2020 by the talk of eminent scientist, educationist, Padma Vibhushan awardee and former chairperson, Atomic Energy Commission of India, Dr. Anil Kakodkar. Since then we have had several lecture in this series every week.

All the lectures in this series can be viewed on our GYAN YouTube channel
https://www.youtube.com/channel/UCZ5NdeQyicv_szzIqATaO_w.

Placements

The lists below are only a few representative graduates and are not exhaustive.

Research

S. No.	Name	Degree	Year	Position	Organisation
1	Raj Shah	M. Sc.	2019	PhD	INO, TIFR, Mumbai
2	Amit Chavan	M. Sc.	2019	Trainee SO	BARC, Mumbai
3	Atul Prajapati	M.Sc.	2018	PhD	GSSI, Italy
4	Nidhi Tiwari	M. Sc.	2018	PhD	Institute of Science, Mumbai
5	Amin Neeraj Singh	M.Sc	2018	PhD	Karlsruhe, Germany
6	Pendhurkar Mansi Vilas	M.Sc	2018	PhD	BARC, Mumbai
7	Shaikh Aqsa Zahid	M.Sc	2018	PhD	SAMEER, IIT-Bombay
8	Maurya Surendrakumar	M.Sc	2018	PhD	SAMEER, IIT-Bombay
9	Manan Jain	M.Sc	2018	PhD	Lawrence University, Italy
10	Tamsi Kar	M.Sc	2018	PhD	Heidelberg, Germany

11	Rushabh Gala	M.Sc	2017	PhD	North Carolina State University, USA
12	Ankita Kule	M.Sc	2017	PhD	IISc, Bengaluru
13	Vivek Singh	PhD	2016	PhD	VECC, Kolkata
14	Adiba Shaikh	M.Sc	2016	PhD	IIT Bombay
15	Sumukh Purohit	M.Sc	2016	PhD	JNCASR, Bengaluru
16	Suraj Gupta	PhD	2016	PDF	IIT Bombay
17	Kamalnayan Chauhan	M.Sc	2016	Dip RP	BARC, Mumbai
18	Samata Gokhale	M.Sc	2016	JRF	TIFR, Mumbai
19	Sumukh Purohit	M.Sc	2016	PhD	JNCASR, Bengaluru
20	Adiba Shaikh	M.Sc	2016	JRF	TIFR, Mumbai
21	Gauri Datar	M.Sc	2016	PhD	IIG, Mumbai
22	Zubair Shaikh	M.Sc	2016	PhD	IIG, Mumbai
23	Jain Manan	M.Sc	2015	PhD	University of Florence
24	Avanti Gogate	M.Sc	2015	PhD	Univ. of Groningen, The Netherlands
25	Pooja Billimoga	M.Sc	2015	PhD	Univ. of Groningen, The Netherlands
26	Siddhesh Padwal	M.Sc	2015	JRF	UDP, Mumbai
27	Niharika Rout	M.Sc	2015	PhD	IIT Madras
28	Tamasi Kar	M.Sc	2015	PhD	University of Heidelberg, Germany
29	Abhijit Bhogale	PhD	2015	PDF	UDP, Mumbai
30	Abhishek Iyer	M.Sc	2014	PhD	LNGS, Italy
31	Ajay Lotekar	M.Sc	2014	JRF	IIG, Mumbai
32	Deepak Nayak	M.Sc	2014	SA	NPCL
33	Hari Iyer	M.Sc	2014	Proj. Intern	IPR, Gandhinagar
34	Nakul Karle	M.Sc	2014	PhD	Univ. of Texas, USA
35	Pradeepkumar Yadav	M.Sc	2014	PhD	BITS, Pilani
36	Sonal Patel	M.Sc	2014	JRF	TIFR, Mumbai
37	Anil Bohra	M.Sc	2013	PhD	BARC, Mumbai
38	Shazia Shaikh	M.Sc	2013	JRF	BARC, Mumbai

Teaching

S. No.	Name	Degree	Year	Position	Organisation
1	Jyothi Misra	M.Sc	2019	-	Vidyavardini College, Vasai (W)
2	Ankita Parab	M.Sc	2019	-	Narayana Education Trust, Thane
3	Manjiree Thakur	M.Sc	2019	-	KBP College, Navi Mumbai
4	Prashantsagar Yadav	M.Sc	2018	Teacher	MBBI Educational Trust, Palghar
5	Gaurang Tawde	M.Sc	2018	Teacher	B. N. Bandodkar College, Thane
6	Saumya Pandey	M.Sc	2018	-	Vidyavardini College, Vasai (W)
7	Rasika Raut	M.Sc	2017	-	St. John Junior College, Palghar
8	Sneha Ansurkar	M.Sc	2017	Asst. Professor	University of Mumbai
9	Sneha Buwa	M.Sc	2016	Asst. Professor	Maratha Vidya Prasarak Samaj, Nashik
10	Rupesh Bawlekar	M.Sc	2016	-	St. John Junior College, Palghar
11	Dhanashree Haldavnekar	M.Sc	2016	Lecturer	VES College
12	Kajal Tiwari	M.Sc	2015	Lecturer	VESIT College
13	Kamlesh Kadam	M.Sc	2015	Lecturer	Xaviers junior college
14	Monika Kadav	M.Sc	2015	Lecturer	SDD College, Wada
15	Anil Raghav	PhD	2015	Asst. Professor	UDP, Mumbai
16	Kamlesh Kadam	M.Sc	2015	Teacher	St. Xaviers College, Mumbai
17	Aditya Pal	M.Sc	2014	Asst. Professor	CKT College, Panvel
18	Amir Khan	M.Sc	2014	Teacher	
19	Anil Yadav	M.Sc	2014	Asst. Professor	
20	Samantha Wesley	M.Sc	2014	Asst. Professor	IMJ College, Vashi
21	Shruthi Thayyil	M.Sc	2014	Asst. Professor	KLE Society's Education College, Kalamboli
22	Elsa Jacob	M.Sc	2013	Teacher	
23	Love Trivedi	M.Sc	2013	Asst. Professor	R.D National College
24	Manuel D'Souza	M.Sc	2013	Teacher	Podar International School, Santacruz
25	Shaili Badhani	M.Sc	2013	Teacher	IBDP and CIE, International School
26	Sneha Salap	M.Sc	2013	Lecturer	

Industry

S. No.	Name	Degree	Year	Position	Organisation
1	Kalyani Kavde	M.Sc	2018	-	Quess Corp. Ltd.
2	Rajagopal Rahul	M.Sc	2018	-	Fiber Optic Services Ltd.
3	Rajendra Dakua	M.Sc	2014	Material Manager	ONGC
4	Smitha Poojary	M.Sc	2014	Geographic Technician	Nokia
5	Divakar Chunarkar	PhD	2014	-	Industry
6	Nirmal Thorat	M.Sc	2013	Application Engineer	SMT Vasai

10 Miscellaneous Information

10.1 Location

The Department of Physics is housed mainly in Lokmanya Bal Gangadhar Tilak Bhavan and partly in Sant Dnyaneshwar Bhavan located at the beautiful Vidyanagari Campus of the University of Mumbai. The Vidyanagari Campus is off the C.S.T. Road, now known as Vidyanagari Marg, near Kalina.

10.2 How to reach

Kalina Campus is accessible both from Central Railway (Kurla station) and Western Railway (Santacruz station). BEST buses 318, 313, 312, 37, 181, 213, 374, 306 and 449 pass via Vidyanagari Campus connecting different parts of the city of Mumbai.

10.3 Scholarships

The Department offers ‘Merit Scholarships’ and one ‘Shri Nitin Rasiklal Parikh Memorial Scholarship’. These are awarded strictly on the basis of merit. There is also the ‘Late Principal R. D. Godbole award’ for a student standing first among those offering Nuclear Physics option. In addition, for financially needy students, department offers three ‘Free Studentships’ to be awarded on the basis of need-cum-merit. ‘Earn-and-learn scheme’ for M. Sc. students under Vice-Chancellor’s scheme and Research Fellowships for Ph.D. students are offered by the Department. There are other scholarships which are available in the Department of Physics for meritorious and deserving students. These assistantships are available to only those students who are enrolled in the Department.

10.4 Central Library

The Jawaharlal Nehru Library at the Vidyanagari Campus is well equipped with Physics books, journals and periodicals. The students enrolled in the Department can avail of both the reading as well as lending facilities offered by the library.

10.5 Hostel Accommodation

There are Girl’s and Boy’s hostels within the Campus. There are eight seats in Boys’ hostel and eight seats in Girls’ hostel reserved for the students of the Department of Physics. One seat is available at Jagannath Sankar Seth Hall / Hostel for boys’ at Churchgate ”B” Road, Mumbai-400 020.

