

## CURRICULUM VITAE

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### **1. SUMMARY**

- Over 25 years of experience in Physics Education Research and Development (PER&D) and training of students and enriching / mentoring of in-service teachers in experimental physics.
- Key areas of research and development include: Training in experimental physics, experimental problem solving, procedural understanding in physics, physics laboratory courses for students and teachers, instructional strategies for laboratory courses, assessment tools and strategies in experimental physics and instrumentation for physics laboratories.
- Academic Coordinator of the National Initiative on Undergraduate Science (NIUS) in Physics at the Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai and the person in-charge of NIUS in experimental physics.
- Key member and coordinator of the experimental component of Physics Olympiad programme at HBCSE (1997 to 2006).
- Major contributions towards development of Physics training laboratories at HBCSE and a few other institutions in India.
- Extensive experience in designing and development of novel instruments, components, mounts, measurement systems, and experimental setups for physics training laboratories.
- Conceptualised, designed, and conducts the Summer Course in Experimental Physics (SCEP) at HBCSE.
- Experience in conducting workshops for teachers, educators, and researchers involved in physics laboratory courses at school, college and university level.
- Publications in national / international peer-reviewed journals and conference proceedings.
- Attended several conferences / workshops and delivered numerous invited talks and presentations across various forums.

### **2. AREA OF RESEARCH AND DEVELOPMENT**

#### **2.1 Training in Experimental Physics**

Studies on importance and role of laboratory training, objectives and goals of physics laboratory courses / training, analysis of instructional and assessment strategies, understanding experimental skills and other abilities related to experimental physics, teacher's ideas on various aspects of training in experimental physics, understanding entanglement of conceptual understanding, scientific information and cognitive abilities, development of instructional strategies / methods of instruction for the laboratory training at school and undergraduate (UG) level, development of assessment strategies and tools for various abilities related to experimental physics (i.e., tests on conceptual understanding, procedural understanding and experimental tests), development of laboratory courses for students, designing teacher-enrichment programmes in experimental physics, development of 'content' for undergraduate physics laboratories, that include development of innovative experiments, student projects, and demonstrations in physics, preparation of writeups and handouts for students and teachers, designing of training laboratories in physics with respect to 'content' and infrastructure.

## **2.2 Experimental Problem Solving' (EPS)**

EPS as an instructional approach for training of students in experimental physics, understanding deeper cognitive basis, stages and processes that can define and simplify EPS, developing possible models for EPS, analyzing student's difficulties in EPS, and designing activities, teaching modules and laboratory courses to foster EPS.

## **2.3 Procedural Understanding (PU)**

Studies on PU in physics, identifying concepts of evidence and PU in physics at the UG level, study of student's and teacher's ideas on conceptual and procedural understanding, how to distinguish PU from other skills (psycho-motor) and abilities (cognitive, affective, etc), various methods to foster PU, designing experimental problems / pen-and-paper type questions / assessment tools for PU, developing activities and teaching modules on PU for students and teacher professional development.

## **2.4 Electronics and Instrumentation for Physics Training Laboratories**

Designing and development of novel instruments, equipment, measurement systems, components and mounts, complete experimental setups for training laboratories at school and university level.

## **3. EDUCATIONAL QUALIFICATIONS**

**Ph. D. (Science)** in Science Education, University of Mumbai, Mumbai, India

- Worked at: HBCSE, TIFR, Mumbai, India
- Duration: June 1995 - August 2001
- Major Area: Physics Education Research and Development (PER&D)
- Thesis: Development of innovative experimental problems and demonstrations in physics with suitable instructional strategy for them and investigating their effectiveness in laboratory training.
- Supervisor: Prof. H. C. Pradhan, HBCSE, TIFR, Mumbai, India

**M. Sc. (Physics)**, Nagpur University, Nagpur, Maharashtra, India

- Studied at: Department of Physics, Nagpur University, Nagpur, India
- Duration: June 1992 - May 1994
- Specialization: Solid State Physics and Digital Electronics
- Project: Design and fabrication of a microprocessor based X-ray diffractometer. (under the guidance of Prof. V. B. Sapre, Department of Physics, Nagpur University, Nagpur)

**B. Sc.**, Nagpur University, Nagpur, Maharashtra, India

- Studied at: Jankidevi Bajaj College of Science, Wardha, Maharashtra, India
- Duration: June 1989 - May 1992
- Major Subjects: Physics, Mathematics and Electronics

## **4. PROFESSIONAL CAREER**

- Homi Bhabha Centre for Science Education (HBCSE), TIFR, Mumbai, India
  - Reader (F): January 2009 - till date
  - Fellow (E): February 2006 - December 2008
  - Fellow (D): January 2003 - January 2006
  - Visiting Fellow: October 2001 - December 2002
  - Research Scholar: June 1995 - September 2001
- Department of Applied Physics, Shri Ramdeobaba Kamla Nehru Engineering College, Nagpur, Maharashtra, India
  - Lecturer: December 1994 - May 1995

## **5. VISITING POSITIONS**

- Visiting faculty member at the Ashoka University, Sonapat, Haryana, January 1 - May 11, 2018.
- Visiting faculty member at the University of Mumbai - Department of Atomic Energy - Centre for Excellence in Basic Sciences, (UM-DAE-CEBS), Mumbai, September 2007 - November 2008.

## **6. MEMBERSHIP OF PROFESSIONAL ORGANIZATIONS**

- TIFR Alumni Association (TAA)
- Indian Association of Physics Teachers (IAPT)
- Indian Physics Association (IPA)
- Instrument Society Of India (ISOI)
- International Research Group on Physics Teaching (GIREP)
- European Science Education Research Association (ESERA)
- American Association of Physics Teachers (AAPT)
- World Federation of Physics Competitions (WFPhC)

## **7. DETAILED PROFESSIONAL CONTRIBUTIONS AND EXPERIENCE**

### **7.1 NATIONAL INITIATIVE ON UNDERGRADUATE SCIENCE (NIUS) IN PHYSICS**

- Academic coordinator of the NIUS (Physics) at HBCSE since 2009 and the person in-charge of NIUS in experimental physics.
- Developed laboratory facilities at HBCSE for student research in experimental physics.
- Offered proto-research student projects in physics, trained and mentored a number of number of NIUS students:
  - Number of projects offered = 48
  - Number of students who initiated the project = 67
  - Number of students who completed their projects = 23
- Developed laboratory courses for training in experimental physics and implemented them during the nurture camps at HBCSE.
- One of the Principal Investigator (PI) for the NIUS project for 11th (2007 - 2012), 12th (2012 - 2017) five-year plans and the current plan.

### **7.2 INSTRUMENTATION PROJECT**

- Conceptualized and proposed a project under the NIUS titled “Development of Novel Instruments and Experimental Setups for the Undergraduate Physics Teaching Laboratories”.
- Developed a basic instrumentation laboratory and a mechanical workshop / maker’s space facility where several students were trained in various aspects of design, fabrication and instrumentation.
- Designed and developed more than 12 complete experimental setups and more than 15 stand-alone instruments, components, mounts and measurement systems.
- Worked with manufacturers and suppliers to make these experimental setups and instruments available to colleges and institutions in India.

### 7.3 INDIAN NATIONAL PHYSICS OLYMPIAD (INPhO) PROGRAMME

- Coordinator of the experimental component of INPhO at HBCSE from 2000 to 2006.
- Played an important role in planning, organizing, and conducting the physics olympiad training, orientation and selection camps at HBCSE from 1997 to 2007.
- Proposed and coordinated resource generation camps (RGCs) for the experimental component of the INPhO (2003 - 2006).
- Developed a number of experimental problems, setups, and question papers for the training and evaluation of students for the INPhO and the training camps at HBCSE.
- Member of the national board (experimental component) for development of experiments, training, and evaluation during the INPhO (1998 - 2009).
- Scientific observer in the Indian delegation for the 45<sup>th</sup> International Physics Olympiad held at Astana, Kazakhstan (July 13 - 21, 2014)
- Pedagogic leader of the Indian delegation for the 36<sup>th</sup> International Physics Olympiad held at Salamanca, Spain (July 3 - 12, 2005).
- Pedagogic leader of the Indian delegation for the 35<sup>th</sup> International Physics Olympiad held at Pohang, South Korea (July 15 - 23, 2004).
- Member of the academic committee and coordinator for experimental component for **13<sup>th</sup> Asian Physics Olympiad (APhO) 2012**, New Delhi, India, (April 30 - May 7, 2012).
  - Developed one of the (two) experimental problems (in collaboration with Prof. D A. Desai, IAPT, Mumbai) on ‘electromagnetic induction’.
  - Designed, fabricated the prototype of the apparatus, standardized the experimental apparatus, and shouldered the responsibility of making 100 copies of the experimental setups.
  - Organized a preparatory workshop at HBCSE.
  - Conducted the experimental competition at New Delhi in two batches of about 90 participants.
- Member of the core organizing group, the academic committee, and the coordinator of the experimental component for the **46<sup>th</sup> International Physics Olympiad (IPhO) 2015**, Mumbai, India, (July 5 - 12, 2015).
  - Involved in preparatory work required for the experimental component of the IPhO.
  - Handled academic as well as organizational responsibilities of the RCGs for the experimental component (March - April 2014).
  - Worked on one long (5-hour) experiment, designed apparatus, got several copies made, and tested them for consistency and reliability.
  - Organized a preparatory workshop for checking of apparatus and collection of data at HBCSE during April 20 - May 29, 2015.
  - Took the responsibility of identifying, pursuing and hosting all the 51 members of the Academic Assessment Group.
  - Prepared and executed a detailed proposal for fair distribution and sale of IPhO experimental kits to several individuals / colleges / agencies in India.
  - Proposed and prepared a video presentation on “How to assemble the complete experimental setup” for Experimental Task 1 (E1) and Experimental Task 2 (E2) of IPhO.

## **7.4 TRAINING OF STUDENTS IN EXPERIMENTAL PHYSICS**

- Conceptualised, coordinated, and a key resource person for the ‘**Summer Course in Experimental Physics**’ (SCEP) conducted at HBCSE for the UG students since 1999.
- Designed the SCEP based on the ‘Experimental Problem Solving’ approach for UG students. The approach has been so designed to encourage student’s independent thinking and designing in physics laboratory and to foster procedural understanding, integrated view of theory and experiments, conceptual understanding, experimental problem-solving ability and experimental skills.

## **7.5 WORKSHOPS FOR AND MENTORING INSERVICE TEACHERS**

### **7.5.1 Workshops for Teachers at HBCSE**

- Conceptualized, designed and organize, since 2012, the **Exposure cum Preparatory Workshop (EPW)** for teachers, educators and researchers who are involved in physics laboratory courses.
- Proposed and conducted NIUS workshop on ‘Active Learning in Optics and Photonics (ALOP) and Experimental Problem Solving (EPS)’ in Physics for 46 teachers during January 10 - 12, 2018.
- Workshop on ‘Development of instruments and experimental setups for undergraduate physics teaching laboratories’ for 18 teachers in April 2014.
- Workshop on ‘Interfacing science experiments with computers’ for 16 teachers in collaboration with Dr. B P Ajithkumar, IUAC, New Delhi on December 3, 2011.
- Workshop on ‘Training in Experimental Physics: Some PER Initiatives’ for 40 teachers, on December 29, 2011. This workshop was in collaboration with Department of Physics, University of Mumbai and Academic Staff College, University of Mumbai.
- Workshop on ‘Procedural Understanding in Physics’ for 55 teachers, September 10 - 12, 2009.

### **7.5.2 Workshops / Contributions for Teachers Elsewhere**

- Actively involved in various training programmes/workshops organized for teachers all over India.
- Supported various organizations in designing and conducting teacher workshops in physics.
- Conducted physics laboratory training/sessions during a number of teacher orientation programmes organized by HBCSE-Mumbai, AEES-Mumbai, IAPT, CDPE-Jaipur, NLI-HCU Hyderabad, BASE-Mumbai, ASC’s and UGC.
- Member of the National Advisory Committee and a resource person for a UGC and IAPT supported National Workshop Cum Seminar on ‘Physics Education Research (PER): Research Based Reforms in Physics Instruction’ held at St. Bede’s College, Shimla, HP University during May 22 - 29, 2011.
- IAPT Workshop on “Revitalizing the Physics Laboratory Training at the undergraduate level”. Key resource person in the planning and conducting of a workshop at the Centre for Development of Physics Education (CDPE), University of Rajasthan, Jaipur during March 25 - 29, 2009.

### **7.5.3 Short Term Visitor Programme at HBCSE**

- Guided a number of teachers from various schools and colleges in India, who worked for one to two months on various experiments / projects in experimental physics and PER.

## **7.6 PHYSICS LABORATORY TRAINING**

- Developed laboratories for training in experimental physics at HBCSE, TIFR, Mumbai that are being used for the Physics Olympiad, NIUS and various other courses for students and teachers.
- Studied existing practices of physics laboratory training in India and developed ‘content’ and ‘strategies’ for the physics laboratory training.
- Developed large number of innovative experiments, student projects and demonstrations in the area of mechanics, optics, electronics, instrumentation, electricity and magnetism.
- Resource person and invited speaker in experimental physics for a number of programmes organized for students and teachers.

## **8. TEACHING EXPERIENCE / COURSES TAUGHT**

### **8.1 Graduate Courses Taught at HBCSE**

- A full semester 4-credit elective course titled ‘Introduction to Physics Education Research and Development (PER&D)’, Academic Year 2016 - 17, Semester I (August - November 2016).
- A full semester 4-credit course titled ‘Introduction to Physics Education Research (PER)’, Academic Year 2011 - 12, Semester II (January - April 2012).
- A 2-credit ‘Foundation Course in Physics’, Academic Year 2010 - 11, Semester I (August - December 2010).
- Coordinator and one of the (four) faculty members who taught a 4-credit ‘Foundation Course in Science’ offered during the Academic Year 2009 - 10, Semester I (August - December 2009). Taught a course (14 hours) in physics during September 22 - October 22, 2009.
- Foundation course in experimental physics, for the graduate students at HBCSE, Mumbai (August 10 - September 10, 2007).

### **8.2 Courses Taught Elsewhere**

- ‘Introduction to Physics through Experiments’ at Ashoka University, Sonapat, Haryana, as a visiting faculty, January 1 - May 11, 2018.
- Physics laboratory course (PL 101) at UM DAE CBS, Mumbai, as In-charge of the course, 56 hours (September 2007 - January 2008).
- Physics laboratory course (PL 201) at UM DAE CBS, Mumbai, as an Instructor, 48 hours (February - May 2008).
- Physics laboratory course (PL 101), at UM DAE CBS, Mumbai, as In-charge of the course, 64 hours (August - November 2008).
- Physics laboratory course (PL 301), at UM DAE CBS, Mumbai, as In-charge of the course, 120 hours (August - November 2008).

## **9. INVOLVEMENT AT NATIONAL AND INTERNATIONAL LEVEL**

- Chaired oral presentation sessions on Physics Education and PER during conferences and symposiums, which include International Conference on Physics Education ICPE-SAIP-WITS (October 2018, Johannesburg), International Conference on Physics Education ICPE-EPEC (August 2013, Prague), and IAPT National Convention (October 2017, Haridwar), etc.
- Member of the editorial board of the Physics Education ([www.physedu.in](http://www.physedu.in)), a journal published by IAPT, ISRO and DAE (2009 - 2019).

- Member of the National Advisory Committee for the Jawaharlal Nehru National Science, Mathematics and Environment Exhibition (JNNSMEE), NCERT, New Delhi (2013 - 2015 and from 2019 - till date)
- Member of the International Advisory Board, Centre for Experimental Physics Education, LUMS (2013 - 2020)
- Member of the Academic Council, Bajaj College of Science, Wardha, (2020 - till date)
- Member of the National Advisory Board, Bajaj Science Centre, Wardha (2018 - till date)
- Subject expert and a member in the Board of Studies (BOS) in Physics, University of Mumbai (2010 to 2015).
- Member of the Advisory Committee as External Expert, DBT Star College Scheme for B. N. Bandodkar College, Thane (2016 - 2017).
- Member of the Board of Studies (BOS) in Physics at the Ramnarain Ruia Autonomous College, Mumbai. (2017 - 2019)
- Member of physics advisory group on laboratory programme (MSc-Integrated) of the Central University of Tamilnadu, Thiruvarur. (2009 - 2012)
- Developed the first semester physics laboratory course (PL 101) for the five-year integrated MSc programme at NISER, Bhubaneswar and UM-DAE-CEBS, Mumbai. (2007)
- Developed the third semester physics laboratory course (PL 301) for the five-year integrated MSc programme at UM-DAE-CEBS, Mumbai. (2008)
- Contributed to the initial development of physics laboratory programme at IISER, Pune and developed a full semester laboratory course in mechanics. (2006)
- Developed and conducted at HBCSE, a 4-week course in experimental physics for the FY BSc students of Chennai Mathematical Institute (CMI), Chennai. (2004 - 2009)
- Reviewer of books and contributed papers for journals and conferences, which include International Conference on Physics Education (ICPE), GIREP, Episteme conferences, etc.

## **10. OTHER PROFESSIONAL ACTIVITIES / SERVICES**

### **10.1 Other Academic / Administrative / Technical Contributions at HBCSE**

- One of the Principal Investigators (PIs) for the following three plan projects at HBCSE: National Initiative on Undergraduate Science (NIUS), National Science Olympiads (NSO), and Collaboratively Learning to do Experiments and Research (CLEAR).
- Significantly contributed to the development of NIUS infrastructure and physics laboratory facilities at HBCSE which include: NIUS facility building, well-furnished training laboratories, a small workshop / maker's space, laser/spectroscopy laboratory, instrumentation laboratory etc.
- Member of the HBCSE Technical Committee for past several years and its Chairperson since September 2016.
- Member of interview committees for various positions at HBCSE.
- Member of the Core Committee (Technical) at HBCSE.
- Member of the Campus and Garden committee at HBCSE.

### **10.2 Involvement at TIFR, Colaba, Mumbai**

- Member of the Executive Committee, TIFR Alumni Association (TAA) since 2016
- Member of the Official Language Implementation Committee (OLIC) (2014 - 2019)

- Member of the ‘TIFR Team 2022’ for ‘Vision for TIFR in the Next Decade’, 2012
- Member of the Science Popularization and Public Outreach Committee (SPPOC) (2009 - 2016)

### **11. OUTREACH AND OTHER CONTRIBUTIONS**

- Guided several students and teachers from various schools / colleges for development of experiments, demonstrations, science projects, and exhibits.
- Supported schools, colleges and other institutions (as advisor, interviewer, chief guest, judge, mentor) towards popularization of experimental physics, science exhibitions, festivals and fairs.
- Guided schools, colleges and NGO’s in the development of physics / science laboratory facilities and mentored their staff at HBCSE.

### **12. PROFESSIONAL GOALS**

- To undertake research and development that will help India in improving the quality of training of students in various aspects of experimental sciences.
- To motivate young students to take up a career in experimental physics by offering them quality experience and training in experimental physics.
- To encourage, enrich and mentor in-service teachers and educators on various aspects of training in experimental physics.
- To develop world-class ‘Central Institute of Training in Experimental Sciences’ (CITES) and ‘Centres for Training in Experimental Sciences’ (CTES) for training of school, college and university students, teachers, educators and innovators from across India.

### **13. PERSONAL DETAILS**

Nationality: Indian

Date of Birth: 03-05-1972

**Present Address:**

**Office:**

206 B, Second Floor, NIUS Facility  
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Mumbai 400088, India

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Date: February 1, 2021