

Executive Summary

1. Introduction:

The Department of Atomic Energy (DAE) was established in 1954 and its mandate includes

- i. Research, including fundamental research in matters connected with atomic energy and the development of its uses in agriculture, biology, industry and medicine, and
- ii. Advancement of higher mathematics.

In pursuit of its mandate, DAE has established research and development centres as well as grant-in-aid institutions and has taken in its fold several existing institutions as its grant-in-aid institutions. Together, all institutions under the umbrella of the DAE present a formidable group in terms of expertise in science and engineering with world-class research infrastructure.

DAE has been running a “Training School” since 1957 to provide pre-induction training in nuclear science and engineering to fresh engineers and post-graduates in science joining R&D centres of DAE. Given the depth and range of operation of its programmes, the Training School, in fact, has been functioning as a Graduate School. Similarly, several other Constituent Institutions (CIs) of Homi Bhabha National Institute (HBNI) have had a long tradition of human resource development through academic programs in various disciplines.

Considering the continued expansion of the atomic energy programme and considering the fact that the DAE institutions are engaged in human resource development, the DAE, in consultation with all possible constituent institutions, decided to establish HBNI having the status of a deemed university. HBNI was notified as a deemed to be university on June 3, 2005, and started its academic programmes in 2006. It was accredited by NAAC in 2015, as an “A” grade institution, with a CGPA of 3.53 on a 4-point scale.

HBNI brings together eleven premier institutions of the DAE (four DAE units and seven grant-in-aid institutions), under a single research-driven academic framework. The Institute has a distributed structure and is a unitary deemed to be university. Its CIs have already been carrying out advanced research and development for several decades. Setting up of HBNI has ensured that the DAE scientists and scientific establishments remain at the forefront of the pursuit of excellence in research in science and engineering, comparable with the best global standards.

Mission

- The Mission of HBNI is to encourage the pursuit of excellence in sciences (including engineering sciences) and mathematics in a manner that has major significance for the progress of indigenous nuclear technological capability.

Vision

The Vision of HBNI is articulated below:

- To provide an academic framework for integrating basic research with technology development.
- To encourage inter-disciplinary research.
- To nurture an environment for attracting high-quality manpower in the sciences including engineering sciences to take up a career in nuclear science and technology and related areas.

The Core Values of HBNI are:

- **Ethical Conduct:** Always adhere to highest ethical standards in teaching, research and services; resist and relegate dishonesty
- **Student-centric Approach:** Always put good of the students first; keep in mind the good of the student in designing processes and programs.
- **Promote Excellence:** Value excellence in research and foster innovation and creativity; design mechanisms to recognize, encourage and reward excellence; use merit as the only consideration in every process
- **Science for Society:** Recognize the importance of science for the development of society; encourage application of advanced knowledge in sciences including medical and health sciences, to address the needs of the society
- **Focus on National Mission:** Use education and research as tools to meet the needs of the nation in various domains, and particularly nuclear science and technology
- **World Class Education and Research:** Nurture human resources in sciences (including Engineering, Mathematics and Medical & Health Sciences) ; provide access to world class experimental and computational facilities and research problems in frontier areas

Strengths, Weaknesses, Opportunities and Challenges (SWOC)

Strengths

1. Focus on Departmental and National needs in devising programs
2. Decentralized and participative management system with a high degree of flexibility to CIs/OCC to design programs to meet their respective mandate
3. World-class experimental facilities, including unique mega facilities such as nuclear reactors, accelerators, tokamaks etc., and excellent support facilities such as library, computational facilities and discipline-specific modern laboratories.
4. Transparent and rigorous system for student selection, resulting in student population of high quality.
5. Rigorous course work of high standards with a choice-based credit system.
6. Academically robust, nationally and internationally renowned faculty; many faculty members have rich experience in research and teaching even at the time of induction.
7. Frontier areas of research, with opportunities of international collaboration
8. High emphasis on merit, very strong peer pressure on both the faculty and the students to excel.
9. High emphasis on ethics and adherence to Government procedures
10. Utilization of results of academic research in the Department's programs
11. Through its alumni, the Institute is making a valuable contribution to the scientific manpower development in the country. A large number of HBNI alumni occupy positions for implementing hi-tech projects within DAE and in some cases outside, and research and faculty positions in various leading Institutions and Universities.
12. Through the post-graduate and doctoral programs in medical & health sciences, HBNI is contributing significantly to the society by making available a large number of specialists in oncology; HBNI also contributes significantly to skill development in the domains of nursing, radiology, etc.
13. A high faculty to student ratio (0.34 for the academic year 2018-19)
14. Availability of adequate funds from DAE

Weaknesses

1. Pursuit of a meritocratic admission policy sometimes leads to a low intake of students.
2. Misplaced apprehensions about nuclear energy deter some students to join the

doctoral programme run by the university under the DAE.

3. The embargo on the supply of items subject to technology controls to R&D centres sometimes forces students and faculty to devise alternate instrumentation and equipment leading to delays in research
4. First priority of some of the faculty in the CIs which are R & D units of DAE, is to pursue R&D projects towards mission programs of the department. Due to preoccupation with R&D projects, mentoring of students sometimes gets less priority.
5. Due to the availability of alternate non-academic career options, some of the doctoral students leave research before completion.
6. Students are also engaged in research projects related to strategic programs, and while their contributions are indeed very important for the country, they do not get high ranking in terms of scientometric indicators. Also, faculty and students are not permitted to patent their research products if these pertain to atomic energy.
7. While the research work of faculty and students does contribute to industrial units in DAE, there is limited interaction of students with outside industry and limited emphasis on entrepreneurship.
8. Students and faculty in the DAE units need to work in a high security ambience.

Opportunities

1. Enhance utilization and appreciation of the unique mega facilities of DAE by making them available for academic research programs
2. Carry out innovative research in unique areas that cannot be attempted by most other institutes in the country (eg. molten salt chemistry, radiation applications, high-temperature thermodynamics, irradiated material properties, etc.) using the world-class infrastructure
3. Build indigenous scientific instruments for research
4. Carry out cross-disciplinary research utilizing the strengths of various CIs/OCC.
5. Carry out high-level research in frontier areas of basic sciences and engineering having application in national programmes.
6. Contribute to resolving technical issues faced in strategic programs, thus adding high utilitarian value to the academic program
7. To enter into international collaboration on nuclear education with leading countries to expand learning opportunities for students and faculty
8. Offer courses on MOOC platform for benefiting students from HBNI as well as other Universities

Challenges

1. A major fraction of the faculty of HBNI are employees of DAE units tasked with the development of nuclear science and technology. They have to balance their roles as scientists with mission-related responsibilities, and at the same time play an effective role as a mentor and guide for the research students.
2. Similarly, a sizeable fraction of students are employees; they need to address the targets given to them by their organization, besides ensuring that the academic program proceeds without undue delay.
3. The CIs/OCC are distributed through the country, and therefore, day-to-day interaction between faculty or students across the CIs/OCC is only through the use of technology. This introduces delays in evolving common approach in various issues.
4. The geographical constraint mentioned above also makes it difficult for the students to exploit the excellent research infrastructure and knowledgebase available in multiple CIs/OCC.
5. The CIs/OCC were formed at different periods of time, and have a different history, research culture and domain interest. To maintain academic rigor and at the same time, address the diversity of the strengths in different CIs/OCC is indeed a challenge.
6. Due to the special nature of the research domains in DAE, maintaining a strong interface with industry outside of DAE in the research programs is a challenge.

7. Due to the unique characteristics of the university, some of the regulations of statutory bodies need HBNI-specific interpretation for implementation.
8. To publish results of research in strategic topics without compromising on the classified nature of the information.

Criteria wise summary

Curricular Aspects

HBNI offers 32 programmes at doctoral and post-graduate levels in several branches of engineering sciences, physical sciences, chemical sciences, life science, medical & health sciences, and mathematical sciences to meet the requirements of nuclear energy development, its societal and strategic benefits, and to meet the National need for a strong intellectual base.

The CIs and OCC of HBNI have been engaged in academic activities over several decades (e.g. post-MSc course in physics at SINP, Training School at BARC). The MSc programs provide a strong foundation to students through core courses, and introduce students to excitements in the frontiers of knowledge in different branches of sciences, before they embark on research in the field of their choice. The research programs are in frontier areas of science and technology, and are on par with similar programs offered by reputed national and international institutions. The courses offered in BARC, IGCAR, VECC, RRCAT and IPR provide an exposure to several special domains of sciences and technology, such as nuclear reactors and fuel cycle, accelerator physics, lasers and plasma science, and prepare students to embark on a career in DAE as well as organisations working on allied fields. The academic programs in Medical and Health Sciences offer a variety of courses that aim at fulfilling the national needs of cancer treatment and research. A variety of diploma programs serve to generate valuable skills in radiation safety and applications.

The courses have been periodically revised, based on advancements in subjects, feedback from stakeholders. New courses have been introduced to expose students to more recent developments. The curriculum has flexibility for the student to learn subjects relevant to his academic program, in the form of elective courses, besides foundation and core courses. Value addition courses are periodically introduced to benefit not only the students but also faculty. The MoUs signed with several eminent institutions enable the students to take courses in these institutions and earn credits for their coursework. A part of credits can also be earned by taking courses offered in NPTEL or SWAYAM platforms.

Teaching- Learning and Evaluation

HBNI adopts a transparent and robust approach for student selection, adhering to Government guidelines as applicable to HBNI. The students are drawn from all over the country. The demand ratio is very high especially for the selection to BARC training schools, with over 1 lakh applications leading to a final selection of around 150 students in various disciplines. The vibrant integrated 5-year M. Sc. Programme at NISER typically receives about 50000 applications from all over India for a final selection of about 200 students for the integrated 5-year M. Sc. Programme.

A significant fraction of the HBNI students are doctoral students. The Doctoral committee of each Ph.D. student has a unique set of domain experts, with specialists drawn also from outside the CI/OCC. The teaching process is student-friendly and provides a high degree of flexibility. The students are mentored with regard to their academic challenges and also any other issue faced by them. The program outcome and course outcome are evaluated to fine tune the program as necessary. Evaluation and result declaration processes have been speeded up, and typically, a Ph.D. student gets his degree well before six months after submission of his thesis.

All faculty of HBNI are Ph.D. degree holders (except for medical and health sciences where faculty are designated as per guidelines of MCI). Faculty of HBNI are internationally acclaimed experts, and several of

them are fellows of various academies, Bhatnagar prize awardees and civilian awards. Many of the faculty also play key roles in professional bodies and engage in extension and outreach programs. Since faculty are drawn from practicing scientists and engineers, students not only accumulate knowledge but also develop an understanding of the context and application of knowledge.

Research, Innovations and Extension

The CIs/OCC of HBNI have established world-class facilities and infrastructure for research in frontier areas of basic science, nuclear science and technology and allied domains, and these are extended to the students for their academic programs. The Masters programs in HBNI also provide a research exposure to the students which culminates in the form of a Masters thesis. The facilities are periodically updated to enable DAE to be in the frontline of research. Faculty receive adequate funding for research through DAE projects and get generous support to participate in international conferences. In addition to contributing to projects implemented by DAE, HBNI faculty also provide consultancy to other mission programs of the Government including space, and defence. However, due to the nature of the research domains, there is limited emphasis on patents.

HBNI has zero tolerance to plagiarism and every thesis goes through a plagiarism check. The Code of Ethics of HBNI clearly emphasizes the need for exhibiting the highest levels of integrity. The academic programs of HBNI have led to the publication of a large number of papers (around 3000 in 2019) in high impact journals and chapters in books. During the years 2014-15 till 2018-19, 1039 students have received Ph.D. degrees. Some of the CIs (e.g. IMSc) also share their lectures/ courses on MOOC platforms. CIs/OCC also organize lecture programs for the benefit of other segments of society and encourage students to participate in these programs.

HBNI and its CIs have functional MoUs with 13 eminent academic organisations, including INSTN, France and Ghent University, Belgium. Besides research collaborations, these MoUs have also enabled students to take courses in these institutions and earn academic credit.

Infrastructure and Learning Resources

The CIs and OCC of HBNI have excellent infrastructure for academic programs, including class rooms, research laboratories, computing systems, etc. Therefore, the students of HBNI are able to carry out research in areas related to the mission of DAE as well as in frontier areas of science and technology.

All classrooms are equipped with projection facilities; every student gets access to computers, with an average computer/student ratio of 1.3. All campuses have internet connectivity with a bandwidth of 1 GBps or better. Several of the CIs have high-performance computing systems with nationally benchmarked computing speed. The campuses have unique ambience with natural bounty, and all facilities such as ICT enabled seminar halls, auditoria, etc. The students also enjoy the serene and safe atmosphere in the townships/hostel, with excellent sports facilities. The students and faculty are also extended healthcare facilities. High emphasis is placed on maintenance of these facilities through adequate funding.

Libraries at the CIs/OCC have an excellent collection of books, journals, etc., and have a large volume of literature available on the intranet for easy access by faculty and students from their tabletop. BARC library is among the largest libraries in the country in terms of scientific resources. Some of the CIs also have facilities for videocontent creation. For example, IMSc has a dedicated media centre and has hosted a collection of around 900 hours of video content on its web page. IMSc also has a youtube channel (“matscience”) featuring videos on a large number of lectures in mathematics and allied subjects.

Student Support and Progression

Students of HBNI enjoy several benefits. No tuition fee is charged for most of the academic programs. All non-employee students receive fellowships. The meritorious students in the 5-year integrated Masters program receive monthly scholarships from DAE or DST and yearly contingency amount to purchase books etc

or carry out a summer research internship. Doctoral students also get yearly contingency amount to purchase books and computers, attend national conferences, to pay membership fees of national bodies, etc., in addition to Fellowships. HBNI provides financial support to Doctoral Students to participate in international conferences to present their papers. CIs/OCC have anti-ragging measures in place, and a grievance cell to address the problems of students.

The PG diploma programs DipRP and DMRIT are so much in demand that all the students are assured of placement. All the M.Tech. students and around 30 % of the doctoral students are DAE employees. More than 90% of students passing out from the masters programs pursue higher education, and many have secured PhD positions in top institutes in India and abroad. Guides of doctoral students also advise them on the post-doctoral career.

Students of HBNI participate in various committees for managing the mess, arranging sports / cultural programs, grievance cell, etc. In NISER, there is a student representative in its Academic Council also. At some CIs, research students also organise meets of research scholars across the country. The students in the masters program also regularly participate and organize events such as inter IISER-NISER sports and cultural meets.

Alumni of HBNI have occupied positions in eminent organisations, and provide academic support as and when required. Being Government-funded organisations, the need for funding from alumni has not been felt and therefore there has been no emphasis on this aspect.

Governance, Leadership and Management

The main objective of HBNI is to provide an academic framework for integrating basic research with technology development. To deal with the diversity of academic programs and R&D goals of the CIs and OCC, HBNI has a unique distributed academic governance mechanism, that ensures that the institutions are able to meet their individual objectives, while adhering to a common set of academic standards. Various bodies of HBNI that take all major decisions regarding the academic processes, have members from all the CIs/OCC, thus implementing participative management. The Council of Management is chaired by Secretary, DAE and has among its members, senior administration officials from DAE Secretariat, to ensure that Government guidelines are followed, and the path of HBNI is in line with its vision and mission. Adequate funding is provided by DAE for the creation and maintenance of infrastructure for research and education, and the utilization of funds is monitored through a financial audit. Several welfare measures such as good accommodation, health care and performance-related incentives have helped in providing an ambience that promotes excellence in faculty. DAE has implemented a merit-based promotion system for the faculty as well as technical staff. National and International collaborations have not only enriched the research programs, but have also brought recognition for the faculty. Quality improvement initiatives are encouraged, including accreditation of labs by NBL / ISO. Over the years, several quality improvement measures have been introduced that have enhanced the satisfaction levels of various stakeholders and also academic achievements.

Institutional Values and Best Practices

Established in the name of Homi Bhabha, an iconic leader who stood for excellence and indigenous development, HBNI has emphasized these values in every activity. All the CIs/OCC have excellent campuses with emphasis on cleanliness, greenery, waste minimization and recycling, energy-efficient lighting, and adoption of environment-friendly practices. Water conservation measures and rainwater harvesting are implemented in most of the campuses. As eminent, world-class institutions, the CIs/OCC have well-defined procedures for waste management. Regulations of the statutory body with regard to hazardous chemical waste and radioactive waste are followed scrupulously.

HBNI has merit alone as a factor in designing its processes, and this has ensured that all its students or faculty function in an environment of harmony and equity. The security measures at the campuses provide a safe ambience for women students and faculty. All the CIs/OCC celebrate National festivals, and special commemorative events in the memory of great leaders, promoting National Integration, social harmony and

unity. Ethical practices and adherence to constitutional obligations are always given high priority. All CIs/OCC have implemented anti-plagiarism measures. Hindi being the official language of India, students and employees are exhorted to use Hindi in their communications.

The core values of HBNI are in line with the vision of DAE to provide sustainable solutions to society through scientific research. As part of this approach, the high-end facilities available at the CIs/OCC are made available to students for their research needs, and research programs of high value for the society are specifically encouraged.

Additional Information:

HBNI is a research university with a unique structure. It has 10 Constituent Institutions (CIs), and one Off-Campus Centre (OCC), all under the umbrella of DAE. These are:

1. Bhabha Atomic Research Centre (BARC), Mumbai
2. Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam
3. Raja Ramanna Centre for Advanced Technology (RRCAT), Indore
4. Variable Energy Cyclotron Centre (VECC), Kolkata.
5. Saha Institute of Nuclear Physics (SINP), Kolkata
6. Institute for Plasma Research (IPR), Gandhinagar
7. Institute of Physics (IoP), Bhubaneswar
8. Harish-Chandra Research Institute (HRI), Allahabad
9. Tata Memorial Centre (TMC), Mumbai and
10. Institute of Mathematical Science (IMSc.), Chennai
11. National Institute for Science Education and Research (NISER), Bhubaneswar (OCC).

The profile of programs and governance system of HBNI are unique in several respects. HBNI educates students at the doctoral and masters level. HBNI is a grant-in-aid institute of DAE and the CIs/OCC of HBNI are either units of DAE or autonomous Grant-in-aid institutes of DAE. Thus, a significant number of faculty are employees of DAE; also, employees constitute a significant fraction of the Ph.D student strength. Government guidelines are followed in all the administrative and financial processes in CIs/OCC; however, in all academic matters, the guidelines and rules of HBNI are followed by all CIs/OCC. Finally, many CIs of HBNI, in line with their mandate, pursue purely basic research, while research in other CIs, particularly the DAE units, has a focus on national mission programs.

A major part of the research output of HBNI is of direct relevance to the nuclear program, and such output leads to in-house incubation of related technologies. The research output has also been raising steadily and has received international acclaim. For instance, "Nature Index 2020" has placed HBNI at the fourth position among all Indian institutions. In the 2020 NIRF ranking, HBNI was placed at the 14th position among the Universities and secured an overall ranking of 30.

Concluding remarks:

HBNI is a unique university that has imbibed the spirit of DAE with regard to excellence with relevance. Its academic programs are making a significant contribution to the development of indigenous nuclear science and technology capabilities, and societal benefits through its research programs related to cancer care and treatment, and applications of radiation and radioisotopes. Programs at Masters level are making a significant contribution to the pool of scientific man power in the country. HBNI programs are also creating skilled man power of great value to industry and medical profession. The research output from HBNI has earned national and international recognition, as shown by scientometric indicators, and has also significantly contributed to the mission of DAE. By addressing its weaknesses and implementing additional programs, it has the potential to emerge as a unique educational destination for those aspiring to grow into experts in nuclear science/engineering and also in related fundamental sciences.