

## **Self-Study Report (2016-21)**

### **Tata Institute of Fundamental Research, (Deemed-to-be-University)**

#### **Two Best Practices by the Institute**

##### **Best Practice 1: JEST and JGEEBILS:**

###### **1. Title of the Practice**

Coordinating and conducting nationwide M.Sc. and Ph.D. entrance examinations for Physics (JEST) and Biology (JGEEBILS) that are considered as National Eligibility Tests (NETs) by the Government of India.

###### **2. Objectives of the Practice**

**JEST:** Joint Entrance Screening Test is a National Eligibility Test conducted annually to shortlist candidates for Master's and Doctoral degree programmes in Physics and Theoretical Computer Science. More than thirty Institutes invite students for admission interviews based on their JEST scores, reducing the students' burden of giving multiple entrance examinations.

**JGEEBILS:** Joint Graduate Entrance Examination in Biology and Integrated Life Sciences was set up with the objective of streamlining graduate admissions to research programmes with a focus on the life sciences. Students need to qualify this single entrance test to be considered for admissions in 20+ institutions across India.

###### **3. The Context or challenging issues**

In 1998, NCRA-Pune, a TIFR centre, co-founded JEST with the help of four other national institutes in India. Since then, JEST has grown into a consortium of 32 institutions, including four more TIFR Centres, IISERs, IISc, etc. The examination is coordinated by different participating institutions every year and during the pandemic TIFR coordinated JEST safely and successfully.

JGEEBILS emerged from the TIFR entrance examination for Biology in 2012. Since then, more and more institutions have formally recognized it. The number of institutions has now crossed 20, including IISERs, CCMB, NII, NBRC, etc. From 2019, TIFR is conducting this examination in an online mode.

The major challenges are:

- (a) ensuring a secure high-quality entrance examination conducted at pan-India centres
- (b) obtaining support from multiple partner institutions to use the examination for their admissions
- (c) maintaining a uniform quality of question paper across years
- (d) reaching students from remote regions of India

###### **4. The Practice**

**JEST:** A formal MoU was signed by all the 33 participating institutes of the JEST Consortium (<https://www.jest.org.in/participating-institutes>).

Every participating institute organizes the JEST turn by turn. The organizing institute is responsible for announcing the entrance test in pan-India newspapers, managing the website, coordinating with the test centres, evaluating the answer sheets, announcing the results, etc. The organizing institute prepares the question paper with the help of members from the 2 preceding coordinating institutions. This maintains consistency in the question papers. Two sets of question papers are prepared, one set is personally/physically handed to the Managing Director of the Vendor for printing. The back-up question paper is made ready but not printed.

The vendor is outsourced for printing, delivery, scanning of OMR sheets and to generate results. In each center, OMR sheets are sealed in a box in the presence of the JEST representative faculty. The vendor personnel either carries it by flight or sends it by registered post to the organizing Institute.

Four personnels from the vendor correct the OMR sheets in the presence of the JEST organizer. Machines are used to scan the OMR sheet. The answer key is fed into all these machines before scanning. The total mark in each OMR sheet as read by a machine is cross checked with a separate machine. Some Random OMR sheets are checked manually and tallied with the machine read ones.

All member institutes help conduct the JEST in their respective cities and nearby cities with test centres, and share the financial burden. The organizing institute is responsible for sharing the list of successful candidates with their marks and ranking with the rest of the consortium.

**JGEEBILS:** More than 20 of the most prestigious life sciences research institutions across India recognize the JGEEBILS. The exam has a unique format, it has multiple sections across disciplines (General, Physics, Chemistry, Biology). Moreover, the questions probe candidates' understanding of the concepts rather than their memory-based preparation. In recent times, to increase security, accessibility and efficiency, the exam has moved to an online-only system. This new system will be suitable for scaling up the number of candidates and partner institutions while at the same time ensuring student safety in a post-Covid environment.

Both JEST and JGEEBILS are held in around 25-30 centres nationwide, covering more than 20 states and UTs, including Chhattisgarh, Uttarakhand, Tripura, Jammu and Kashmir, Chandigarh etc.

## 5. **Evidence of Success**

**JEST:** Over the years, JEST has become a standard national-level test for admissions to masters and doctoral programmes. This has been recognised as a National Entrance Test by SERB-DST, and all JEST qualified candidates are given equal opportunity and fellowship as against UGC-CSIR NET. More than 10,000 students all over India appear in JEST every year, out of which around 1000 students qualify for admission interviews of participating institutions. Transparency in the management of funds and non-profit motive of the consortium has encouraged more institutions to join.

The process is highly confidential, and utmost secrecy is maintained. No breach in the security has happened so far. There has been no leakage of question paper and no delay in results.

**JGEEBILS:** From a few partner institutions at the initial stage, JGEEBILS now has 20+ institutions as participating institutions (with many others who have applied to be partners whose applications are being considered). In parallel, the number of students applying to sit for the exam has reached about 10,000 annually. The gender ratio of

students is evenly balanced. Students have secured admissions to Ph.D. programmes across the country, including at TIFR, based on their JGEEBILS scores.

## 6. **Problems Encountered and Resources Required**

**JEST:** The main problem is making the entrance test accessible to students from remote regions. The resources required would be to increase the number of exam venues, and to conduct the examination online. The proposal by TIFR in the JEST coordinators meeting that future JEST exams should be held online was agreed by all institutes. Due to covid, there were emergency cancellation of some exam centers so new centers had to be obtained urgently, and there were postal delays in receiving the OMR answer sheets which caused a delay in generation of results.

**JGEEBILS:** The major issue for any nationwide examination is to ensure timely preparation of the questions from a secure question bank, secure printing and distribution of the question papers, secure collection and grading of answer sheets, and distribution of scores to all partner institutions. This requires participation of several TIFR faculty at each step of the process.

## 7. **Notes (Optional)**

The National Education Policy (NEP 2020) has proposed the formation of a National Testing Agency (NTA) that will coordinate examinations at all levels in the education system. The successful conducting of JEST and JGEEBILS examinations over the last many years makes them a good model to follow for admissions to specialized doctoral programmes.

## **Best Practice 2. Vigyan Vidushi:**

### 1. **Title of the Practice**

“Vigyan Vidushi (VV)”, a TIFR advanced programme in Physics (summer school and mentorship) for women students in their first-year M.Sc Physics programme.

### 2. **Objectives of the Practice**

The objective of the practice is to empower women students in Physics to pursue Physics as a research career choice. For this purpose a three-week summer school in Physics was started in 2020 for women students who have completed their first year of M.Sc. The students are taught, inspired, and mentored by successful women scientists. The programme covers basic as well as advanced courses in physics with active tutoring for problem solving, analytical thinking and approaches, special lectures by eminent Indian women scientists, virtual lab tours, sessions on Physics Education Research, career discussion, and interactive mentoring sessions.

### 3. **The Context or challenging issues**

The number of women students taking up careers in STEM disciplines is quite low. Even within the basic sciences, the fraction of women students doing Ph.D. is noticeably small. This further leads to a smaller fraction of women postdocs, faculty members, and researchers in physics. While the underlying reasons for this may be complex, it is envisaged that the VV programme will make a concrete start towards addressing the prevailing situation.

The students in the programme are at the threshold of deciding whether to opt for a Ph.D. and pursue a career in research. This is the time to give them a flavor of

advanced areas in physics that are not normally covered in M.Sc. courses, and make them aware of exciting opportunities in physics as a career. This approach is relevant for students who come from areas and institutions where such opportunities are not readily available.

#### 4. **The Practice**

The programme is organized by TIFR Main campus and HBCSE. Around 50 women students are selected nationwide each year to participate in the programme. The selections are made keeping in mind geographical and institutional distributions for a wider reach. In VV2020 and VV2021 the sessions were online due to the pandemic. In future, the sessions will be held in person or in hybrid mode.

The selected 50 students joined the lectures on Zoom and interacted directly with the instructors. Further about 300 students in VV2020 and 800 students in VV2021 participated via live streaming on YouTube. This extended the reach of the programme to more than 500 institutions in India, and to 25 states and UTs, from Gujarat to Arunachal Pradesh, and from Jammu & Kashmir to Kerala, including Jharkhand, Tripura, etc.

The courses changed partly every year to keep abreast of new findings. While some of the courses focus on strengthening basic understanding of physics, most of them are on topics that may not be normally covered in M.Sc. classes in a University. The distinctiveness of this programme lies in the emphasis laid on research elements and on the unique perspective of researchers. Tutorial sessions were for problem solving, honing their analytical skills whereas, evening sessions were dedicated to Physics Education Research and mentoring sessions including career counselling. Special lectures by eminent women physicists were also organized. Towards the end, discussions led to a review of current research in physics.

VV2020 was one of the first online summer schools started when the use of platforms for online instruction had not become common. A Moodle platform was created for continuous interaction with students including sharing of pedagogical material and answering questions post lectures. Procedures were adopted to encourage questions and feedback even during the lecture. This included the presence of an Academic Coordinator and a Technical Coordinator during each lecture. The Moodle platform provided a seamless connection to Zoom. Detailed guidelines were prepared and training sessions were held for instructors, tutors, academic coordinators, and technical coordinators. Connectivity of every student to the Zoom classroom was tested individually before the school commenced.

A mixed gender team of 60 faculty, postdocs, scientific staff, PhD students, and other staff of TIFR and HBCSE participated in different roles. Faculty from NCRA and ICTS, and many women ex-students of TIFR currently in institutions like NISER, IISc, ISRO, MPI Germany etc. participated as tutors or mentors.

#### 5. **Evidence of Success**

The feedback obtained from students has been overwhelmingly positive. The number of applications have gone up from about 600 in the first year to 900 in the second year, indicating the growing popularity of the programme. Articles on the VV2020 programme have been published in the magazines of the Indian Physics Society and the Association of Asia Pacific Physics Societies. Talks have been given on this programme in various fora that discussed issues related to women in science, and this programme has been hailed as a concrete step in the right direction.

The success of the Physics VV programme in 2020 has inspired the Mathematics and Computer Science schools in TIFR to start their own VV programmes in 2021.

Many VV students have written stating that the programme has given them clarity, confidence and direction, and many who were unsure about continuing their education in physics have indicated that they would like to go for further research in the subject, some in the VV2020 batch have already done so. The real extent of the success of such a programme will only be clear after a few years, when some of these students will go on to become future physics researchers.

#### 6. **Problems Encountered and Resources Required**

The VV was originally envisaged to be a residential programme, but unfortunately it was not possible due to the pandemic. Therefore, VV2020 turned out to be one of the first completely online summer schools. This gave an opportunity for reaching out to a larger set of students. The lessons learnt from it were later used in conducting the TIFR coursework online and the VV2021 session.

An online version cannot replace the experience of in-person teaching-learning process, especially in a discipline like physics, where experimental work is crucial. In future, it will be organized as a residential programme. Logistical arrangements, finances for travel, accomodation, and food for students, instructors, and mentors will be needed. It is also envisaged that some of the VV students will be able to do internships in TIFR and get direct experience of frontline research. Funds for these activities will be sought from government and private sources.

#### 7. **Notes (Optional)**

It is envisaged that the VV initiative will expand to include further activities that offer more opportunities for women students to find the right fit for their scientific interests. This model may also be adopted by other disciplines and other institutions in the country. In the long run, it should help in more participation of women in STEM, and other sciences, at all levels.