

## Chapter V: Academic Programmes and Research Activities

The Detailed Project Report (DPR) of the Ministry for setting up of new IITs noted that only 5,000 seats were available in the existing IITs as against three lakh aspirants appearing in the Joint Entrance Examination (JEE) during 2006. It was felt that an equal number of talented and deserving students got left out due to lack of opportunity and the situation could be corrected to some extent by establishing additional IITs.

Further, regarding research activities, the DPR stated that the spirit of education in the IITs is ‘research-based learning’ by exposing students to laboratory work in intensive manner. It was also stated that the new IITs are intended to have strong sponsored research activity and develop a research and technology development atmosphere with sizable infrastructure.

### 5.1 Academic Activities

Out of the eight IITs reviewed, academic activities in six IITs<sup>27</sup> commenced during academic year 2008-09 and the other two IITs (IITI and IIT Mandi) during 2009-10.

A performance assessment of these activities was undertaken to check whether the academic programmes and research activities were introduced and carried out as envisioned under three broad audit areas viz., i) Courses and Curriculum, ii) Teaching Environment and iii) Research and Development.

#### 5.1.1 Introduction of Academic Courses

Section 4 of the MoE’s DPR discusses ‘Academic Model of the new IIT’ which visualises the setting up of schools in different technical areas like Engineering Technology, Design and Creative Arts, Management, Health science and Technology, Natural (or Basic) Sciences, Humanities and Social Sciences, rather than setting up departments in various disciplines. This model would encourage academic staff to work together in an interdisciplinary environment and provide a more enriching academic environment to the students. The Senate of IITs were empowered to set up or abolish academic departments, schools and centers and give recommendation to the BoG in this regard.

In line with this vision, each IIT offers various courses/programmes through the respective Schools and Departments. The Perspective Plan of each IIT specifies the targets for setting up of schools/departments and the introduction of courses.

Regarding the introduction of courses, while six IITs had introduced courses as per targets, Audit noticed shortfall in achievement of the targeted introduction of courses in two IITs viz., IITBBS and IITJ as mentioned below.

(i) In IITBBS, out of 27 courses projected in the Perspective Plan (March 2016) for introduction by 2018-19, ten courses (mentioned in the *Table 5.1*) were not introduced till date. As such, students were not offered the option of taking up these courses in IITBBS, inhibiting their choices.

<sup>27</sup> IITBBS, IITGN, IITH, IITJ, IITP and IIT Ropar

**Table 5.1: List of courses proposed but not introduced in IITBBS**

Programme	Specialization/Branch
<b>B.Tech</b>	Energy Engineering, Product design & Development in Industrial Engineering and Management, Environmental Science and Technology and Bio Engineering
<b>M.Tech</b>	Construction Engineering and Management, Electrical Engineering, Cyber Security and Forensic Engineering, Circuits and VLSI Engineering, Material Science and Engineering

Accepting the fact, MoE replied (September 2021) that opening and closing of courses is a dynamic scenario in the IITs. The IITBBS achieved the student strength of 2,486 in AY 2020-21 despite facing difficulties like delayed infrastructure. Nineteen new courses were added during 2015-20. However, 10 projected course plans have not been discarded and these may be taken up in future.

The fact remains that the planning of courses without ensuring the availability of overall resources including necessary infrastructure resulted in the non-introduction of these courses at the appropriate time, depriving students of intended specializations as envisaged.

(ii) In IITJ, Post-Doctoral Fellowship programme which was envisaged to commence from 2011-12 was not started as of March 2019.

Ministry replied (September 2021) that Institute had amended the existing guidelines for engaging post-doctoral fellows which were approved by BoG in October 2019 and efforts are being taken to engage the post-doctoral fellows in due course of time.

### 5.1.2 Creation of Student intake and Enrolment

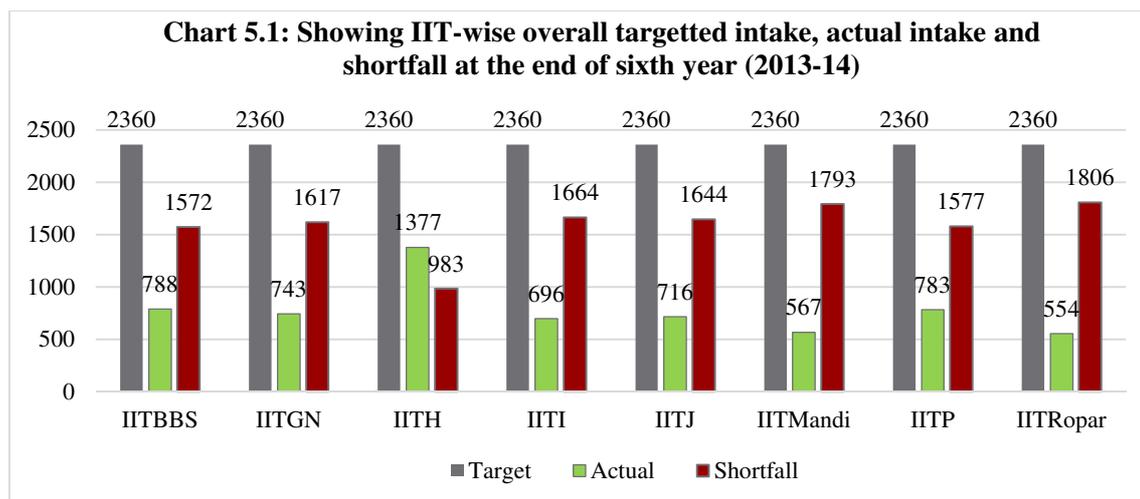
#### (i) Creation of student intake

MoE's DPR on setting up of new IITs during Eleventh five-year plan period stipulated the year-wise intake of students during the first six years as shown in *Table 5.2*:

**Table 5.2: Planned cumulative intake of students by the eight IITs at the end each year during first six years**

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Student intake to the end of year	200	500	900	1450	1900	2360

The actual intake as well as the shortfall in intake as compared to the targets laid down in the DPR are depicted in *Chart 5.1*:



It was observed that none of the eight IITs attained the stipulated cumulative intake of 2,360 students at the end of the sixth year (2013-14). The percentage of non-achievement of targeted intake was highest in IIT Ropar (77 per cent) and lowest in IITH (42 per cent). As against the overall targeted intake of 18,880 students<sup>28</sup>, only 6,224 students (33 per cent) were admitted in all the eight IITs during the first six years, thereby not fully achieving its objectives of maximizing educational opportunity to students. Further, it was observed that till 2018-19, only IITH was able to achieve the targeted student intake.

As per the responses received through MoE (September 2021), IITBBS stated that it has achieved the planned growth already and its intake in 2020-21 reached to the student strength of 2486. IITGN replied that the intake could not be increased due to functioning from a temporary campus till 2015-16, limited hostel accommodation and limited infrastructure. IITGN also stated that it has been increasing its student strength systematically after moving to the permanent campus. IITH stated that the intake was fixed based on the resources available and as approved by the Senate. IITI replied that due to limitations of temporary campuses faced by it and issues relating to allotment and acquiring of land, it could move to permanent campus at the end of calendar year 2015 and thus, it could not meet the targets during initial period. IITI stated that it has reached the student strength of 1900 students in the 10<sup>th</sup> year. IITJ replied that the temporary campuses have limitations in terms of space and other issues and added that student strength increase depends upon the availability of facilities. IIT Mandi replied that it could not achieve the targets due to non-availability of suitable and sufficient infrastructure, insufficient labs and equipment, shortage of faculty and staff, insufficient communication/transport facilities due to remoteness of the area. Accordingly, year-wise targets were fixed and enrolment was done in view of the availability of facilities. IITP replied that due to limited resources and infrastructure the desired strength of students could not be achieved and IIT Ropar did not provide any reply in this regard.

As seen from the reply, the fact remained that slow pace of infrastructure development resulted in shortfall in creation of targeted student intake as envisaged. Hence in its initial

<sup>28</sup> 2360 students for each of the eight IITs

years, the IITs failed to provide the desired access to technical learning, an avowed aim of setting up these campuses.

## (ii) Enrolment of students

Data on the course wise enrolment of students during the period 2014-19 in the eight IITs was examined to assess whether the available student intake capacity was put to optimal use, thereby achieving the intended objectives of academic performance.

The observations and findings of this analysis are discussed in the succeeding paragraphs.

### a) UG Programmes

IITs offer Undergraduate programmes (B.Tech. and B.Des.) in various disciplines of Engineering and Technology. The enrolment of students in UG courses averaged 96 *per cent* of the total available intake in these eight IITs. The shortfall was eight *per cent* in IITJ while the shortfall was two *per cent* in IITH.

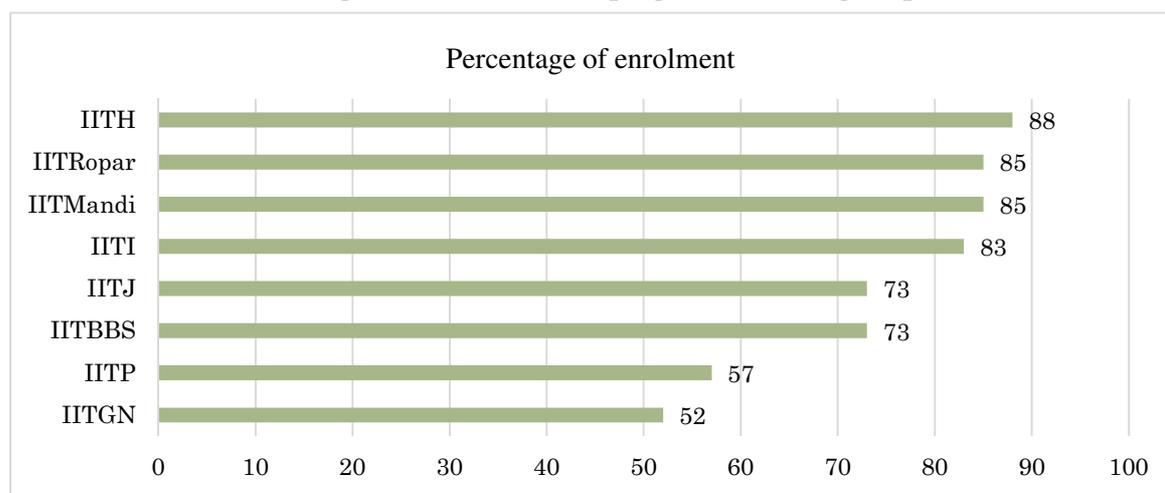
### b) PG Programmes

IITs offer Postgraduate programmes (M.Tech., M.Sc., M.A. and MBA apart from M.Phil) in various branches of Engineering and Technology and other branches. There are two modes of intake for PG i.e.,

- a. MoE funded PG courses (entrance through GATE for M.Tech and through JAM for M.Sc.)
- b. Project funded/industry sponsored/externally agencies funded/self-sponsored.

It was noticed from the information provided by IITs on intake, enrolment and vacant seats in PG programmes, that there was shortfall in enrolment into PG programmes against the available intake in all of the eight IITs during 2014-19 which ranged from 12 *per cent* (IITH) to 48 *per cent* (IITGN). The overall average shortfall was 28 *per cent* across eight IITs (2,193 students against 7,713 seats). This is shown in the *Chart 5.2*:

**Chart 5.2: Percentage of enrolment in PG programmes during the period 2014-19**



The shortfall was minimal in case of IITH, IIT Mandi, IIT Ropar and IITI ranging 12-17 *per cent*, while it was high in IITP and IITGN ranging between 43-48 *per cent*, indicating huge number of PG seats remaining vacant.

As per the responses received through Ministry (September 2021), IITBBS replied that a fraction of PG students do not join even after the waiting list is fully exhausted due to various reasons and left over vacancy is beyond its control. IITGN replied that seats in M.Tech remain vacant because enough suitable candidates are not found despite huge number of aspirants. IITI replied that the enrolment is low due to withdrawal of students after admissions, less representation of candidates from reserved categories etc. IITI stated that it has been striving to increase the enrolment of students in PG programmes. IITJ stated that temporary campus had limitations in terms of space and other issues and that student strength increase depends on availability of facilities. IIT Mandi replied that the reasons were limited applications, withdrawal of students due to various reasons, lack of communication facilities and stated that efforts are made to inspire the candidates and not allow the seats to remain vacant. IITP replied that key reason was less availability of suitable applicants besides shifting of selected candidates to older IITs/joining job assignments after taking admissions. IIT Ropar did not provide any specific reply.

There was no action taken by the MoE in this regard to guide all the IITs to enroll more PG candidates.

### c) Ph.D programme

IITs offer various Ph.D programmes in Engineering and Science disciplines and interdisciplinary areas. The information of IIT-wise intake, enrolment and vacancies during the period 2014-19 was examined. It was noticed that out of the eight IITs reviewed, five IITs (IITI, IITJ, IIT Mandi, IIT Patna and IIT Ropar) offered their Ph.D programmes without fixing the intake in these courses. The remaining three IITs (IITBBS, IITGN and IITH) fixed the year-wise intake themselves at the beginning of each academic year.

Enrolment data showed that in the three IITs (IITBBS, IITGN and IITH) which had fixed their intake, there was a shortfall in admissions, as depicted in *Table 5.3*:

**Table 5.3: Intake vis-à-vis admission in Ph.D programme during the period 2014-19**

Name of the IIT	Total student intake capacity	Total students admitted	Shortfall in admissions	Shortfall (percentage)
IITBBS	1530	308	1222	80
IITGN	1216	432	784	64
IITH	952	788	164	17

The percentage of shortfalls were significant in the case of IITBBS and IITGN indicating, among other things, a lack of interest by the students in the Ph.D programmes offered by these IITs. IITs might like to reassess the utility of these courses and take the initiative to restructure these courses to make them more attractive to students.

Further, the failure to fix intake targets by IITI, IITJ, IIT Mandi, IITP and IIT Ropar deprived these IITs of a holistic approach in ascertaining the present status and future requirements of resources for effective and efficient operation of these Ph.D programmes. This would also affect the availability of skilled manpower from these IITs in the long run.

As per the responses received through Ministry (September 2021), IITBBS replied that enrolment of Ph.D students has increased over last four years and all possible measures are

being taken to improve the enrolment of Ph.D students. IITGN replied that to ensure only high quality candidates are shortlisted, only those candidates with appropriate credentials and research interests are offered admissions. IITI replied that one of the reasons for fewer number of students was paucity of highly motivated research-oriented applicants. IITJ replied that departments take admission of Ph.D students considering the faculty strength and as well as resources available. IIT Mandi replied that no year wise intake was fixed and reasons for less intake were strict selection procedures, limited infrastructure etc. IITP replied that Ph.D students were admitted only after determining their suitability through test/interview. IIT Ropar replied that there was no specific intake for Ph.D courses and scholars are admitted based on faculty/research requirements.

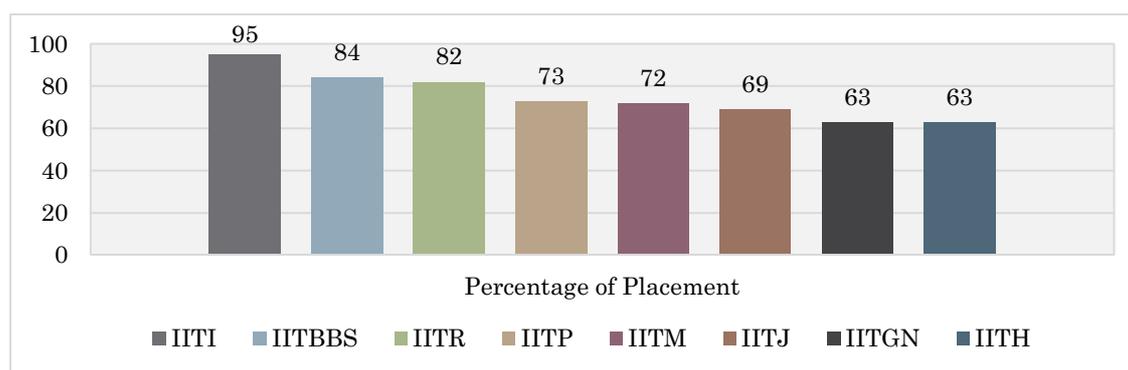
The replies need to be viewed in light of the fact that the targets are fixed by each IIT themselves every year after considering all the resources available. Substantial vacancies despite this indicate that a realistic assessment of the student intake as well as evaluation of the Ph.D programme is not being done even after a decade.

Thus, the objective of providing opportunities in new technical areas to aspiring students by setting up of new IITs was only achieved partially.

### 5.1.3 Campus Placements

Students' placement is one of the metrics for ranking of the Higher Educational Institutions. All IITs have Placement Cells which oversee the placement of students. Placement cells send invitations to companies/organisations and in consultation with the companies, allot dates for campus interviews. After conducting interviews, students are selected for placements by the recruiters. These placement cells of the IITs maintain a database of all the students selected by the companies. The placements according to each IIT is shown in *Chart 5.3*:

**Chart 5.3: Showing IIT-wise percentage of Placements during the period 2014-19**



As seen from the chart above, in terms of percentage of placements, IITI had the highest number of placements (94.69 per cent) followed by IITBBS and IITP. IITGN and IITH need to improve on the placement prospects of their students.

MoE stated (September 2021) that IITP and IITBBS are making efforts to increase the placements of students. However, no specific reply was received in case of remaining six IITs.

## 5.2 Teaching environment

Clause 26 of Act provides for formation of departments of teaching, the qualifications of teachers of the IITs, the method of appointment and the determination of the terms and conditions of service of teachers and other staff. IITs issue rolling advertisement where applicants can apply throughout the year and depending upon the need of the IITs and availability of suitable candidates, interviews are conducted periodically.

### 5.2.1 Shortfall in Faculty positions

MoE sanctioned (August 2008/February 2009) 30 posts per year for initial three years at the time of setting up of IITs. Further, the Ministry permitted the increase in sanction of the faculty positions linked with the increase in the intake of students i.e., sanction of faculty posts is increased by one for every increase in intake of students by 10 (1:10 ratio). Subsequently, the Kakodkar Committee also recommended *inter alia* the faculty student ratio (FSR) as 1:10. IIT Council, while accepting (November 2011) the recommendations of Kakodkar Committee considered the increase in faculty strength across all IITs in the country from around 4000 (2011) to 16000 by 2020, enabling creation of a large pool of high-quality faculty and researchers.

During Audit, it was observed that the IITs have been recruiting faculty consistently. However, the pace of recruitment of faculty did not correspond to the student intake/enrolment, resulting in vacancies in faculty positions. This shortage was observed even to the end of March 2019 in all IITs except in IIT Ropar. The shortfall was significantly higher in IITP (1:14), IITI (1:14), IITGN (1:15) and IITBBS (1:16) as shown in the *Table 5.4*:

**Table 5.4: Faculty student ratio in respect of eight IITs for the Academic Year 2018-19**

Name of the IIT	Student Strength	Number of Faculty as per 1:10 FSR	Number of Faculty in Position	Shortfall	Percentage of shortfall	Faculty Student Ratio
IITBBS	2133	213	137	76	36	1:16
IITGN	1495	150	100	50	33	1:15
IITH	2572	257	197	60	23	1:13
IITI	1822	182	127	55	30	1:14
IITJ	964	96	91	5	5	1:11
IIT Mandi	1281	128	119	9	7	1:11
IITP	1622	162	119	43	27	1:14
IIT Ropar	1476	148	161	-13	-9	1:9
<b>Total</b>	<b>13365</b>	<b>1336</b>	<b>1051</b>	<b>285</b>	<b>19</b>	<b>1:13</b>

As per the responses received through MoE (September 2021), the IITs replied that the vacancies were due to non-availability of suitable candidates despite best efforts to recruit faculty. IITGN, IITBBS, IIT Mandi also added that the shortfall was managed with the services of adjunct faculty from other technical institutes. IITJ did not provide any reason in this regard.

The reply is to be viewed in the light of the fact that inadequate FSR may adversely affect

the quality of education and increase the workload on existing faculty in these premier IITs. This would also constrain their research activities. Further, since the vacancies exist despite rolling advertisement, the IITs need to revisit the recruitment policies without compromising teaching standards by initiating measures like good teaching facilities, good start-up grants, attractive campus environment with residential accommodation and schools for children etc., for attracting quality faculty, as recommended by the Kakodkar Committee.

### 5.2.2 Faculty Workload and Appraisal System

Kakodkar Committee suggested (April 2011) that as a part of appraisal system, faculty could decide what percentage of his/her time and focus in the next year, would be spent on each of the following five parameters namely (i) Teaching (and project guidance), (ii) Research/MS/Ph.D guidance/Research-oriented projects, (iii) Technology development & Industry interaction, (iv) Development of policy/standards and (v) Service. Besides, the goals could also be specified qualitatively in each of these areas, depending upon what the faculty wishes to do. Kakodkar Committee also gave a broad outline for self-appraisal, departmental review and periodical external review of these appraisals.

Against the above criteria, the faculty appraisal system in respect of all the IITs was as in *Table 5.5*:

**Table 5.5: Faculty appraisal system in IITs**

Name of the IIT	Appraisal System
<b>IITH</b>	Senate has mandated that each faculty should teach at least six credits in an Academic Year. It was observed that there was no stipulated research output in terms of publications and research projects for any faculty. Institute replied (September 2021) that workload is being monitored periodically and appraisal system has been introduced.
<b>IITI</b>	Audit observed that faculty had not started setting annual goals for which the IIT replied (September 2021) that self-assessment of the faculty members was periodically collected to check the progress in teaching, research work, industry interaction and their service. The faculty members mention various achievements in the self-assessment form and are endorsed by the Head of Department.
<b>IIT Mandi</b>	No specific norms were fixed by the IIT. The IIT replied (September 2021) that the typical teaching load for a faculty was three courses of three or four credits in an academic year. Further, the teaching load to a faculty member was assigned by the Programme Faculty Group (PFG) for each under - graduate and graduate programme. Each faculty member was expected to submit a self-appraisal report every year which includes detail of his/her workload with respect to teaching, which would be reviewed by a committee headed by the Director.
<b>IIT Ropar</b>	IIT Ropar stated (September 2021) that efforts are on to look at the five parameters as suggested by IIT Council. It also added that it has established a mechanism for entrustment of teaching assignments, research activities in interdisciplinary areas besides vigorous evaluation of faculty was done at each stage of their career growth.
<b>IITP</b>	No specific norms were fixed by the IIT for appraisal system. IITP replied that teaching load was distributed equally viz. one theory and two labs. The reply was silent on appraisal system.

Name of the IIT	Appraisal System
IITJ	In IITJ, the course allocation is done by a department faculty board which entrusts and monitors the teaching load of the faculty members in the department. However, specific norms for appraisal of faculty were not available. IITJ replied that (September 2021) the point is noted for compliance.
IITGN	IIT expects faculty members to contribute their time in the areas of teaching (30%), research (50%) and service (20%).
IITBBS	Information in this regard is not provided by the Institute.

Also viewed against the criteria given by the Kakodkar Committee, the IITs have not fully implemented the Committee's recommendation with regard to faculty workload and appraisal system. MoE may consider developing broad outlines for self-appraisal and departmental review which may then be taken up by all IITs for optimal performance.

Ministry replied (November 2021) that IITs being autonomous institutions, have their own system of reviewing the performance and appraisal of faculty members. The Ministry added that the recommendation of Audit will be circulated to IITs for necessary action in this regard.

### 5.3 Other findings

#### 5.3.1 Inadequate representation of Reserved categories in Student enrolment

As per the Central Educational Institutions (Reservation in admission) Act, 2006, out of the annual permitted strength in each branch of study or faculty, 15 per cent, seven and half per cent and 27 per cent seats shall be reserved for the Scheduled Castes (SC), the Scheduled Tribes (ST) and Other Backward Classes (OBC) respectively.

Audit observed that the representation of the reserved category was not as prescribed, particularly, in respect of PG and Ph.D admissions as shown below in *Table 5.6*:

**Table 5.6: Year-wise representation of category-wise student representation in Postgraduate/Ph.D courses for the five-year period of 2014-19**

IIT	Percentage of Shortfall in enrolment in PG courses			Percentage of shortfall in enrolment in Ph.D courses		
	OBC	SC	ST	OBC	SC	ST
IITBBS	No shortfall	7	37	8	28	65
IITGN	5	30	69	37	68	84
IITH	No shortfall	25	34	1	25	73
IITI	12	No shortfall	13	10	70	97
IITJ	No shortfall	12	55	16	60	100
IIT Mandi	13	23	66	32	61	96
IITP	No shortfall	6	54	No shortfall	61	85
IIT Ropar	6	18	7	36	75	94

- (i) The percentage of shortfall in enrolment of SC students in post-graduate courses was significantly higher in IITGN (30 *per cent*), IITH (25 *per cent*) and IIT Mandi (23 *per cent*). The shortfall in ST students was high in all the eight IITs ranging between 7 *per cent* (IIT Ropar) and 69 *per cent* (IITGN).
- (ii) The percentage of shortfall in enrolment of Ph.D courses was very high in respect of ST category ranging from 73 *per cent* (IITH) to 100 *per cent* (IITJ). In respect of SC students also, the shortfall was significantly higher (more than 50 *per cent*) in all IITs except IITH and IITBBS where it was 25 *per cent* and 28 *per cent* respectively. Under the OBC category, the shortfall was high in IITGN (37 *per cent*), IIT Ropar (36 *per cent*) and IIT Mandi (32 *per cent*).

As per the responses received through MoE (September 2021), IITBBS replied that efforts are being made to enroll adequate students as per the percentage prescribed by GoI. IITGN replied that despite adopting measures like waiver of tuition fee, peer group assisted learning, lower application fee, relaxations given during shortlisting and admission process, seats remain vacant because enough suitable candidates are not found. IITH did not address the shortfall while IITI replied that the shortfall was due to inadequate response by the students belonging to these categories and also stated that it has resolved to fill up the vacancies through special admission drives. IITJ replied that the shortages are mainly due to less number of applicants from specific categories. IIT Mandi replied that the shortfall is attributable to limited number of applications from the reserved category candidates. IITP replied that the shortfall was due to inadequate number of applications from suitable candidates in reserved category. No specific reply was provided by IIT Ropar. The Ministry did not state whether it had thought of any measures for filling up the shortfalls.

### **5.3.2 Peer-group Assisted Learning (PAL)**

IIT council approved (October 2015) Peer-Group Assisted Learning (PAL) strategy wherein educationally and socially backward students were to be tagged to bright student volunteers from senior classes. It was intended to be a fully funded initiative of MoE and was to be operationalised by the IITs to enable fresh students to cope with the academic pressures of IITs.

Audit observed that the initiative was not operationalised in IITBBS, IITJ, IITP and IIT Mandi thereby, denying the intended benefits of the PAL strategy as envisaged by IIT Council.

As per the responses received through Ministry (September 2021), IITBBS replied (November 2020) that they arranged extra classes to improve academic performance of backward students. IIT Mandi replied (September 2021) that the Institute had not received any guidelines/instructions/funding in this regard. IITJ stated (September 2021) that the point is noted for compliance. IITP replied (September 2021) that steps like active interaction of student representatives with freshers, organisation of peer groups in classrooms etc., were being implemented. The MoE also had not taken steps to ensure that all IITs followed this initiative to ensure effective learning opportunities to those who needed it.

The replies need to be seen in light of the fact that the objective of PAL to ensure fresh students from educationally/socially disadvantaged sections are able to cope with the academic pressures of IIT. Non-initiation of the PAL scheme defeated the purpose of reducing the vulnerability of educationally and socially backward students. MoE's lead in implementation of this initiative across all IITs would be instrumental in achieving the objectives of this strategy.

## 5.4 Research Activities

The areas covered during audit also included identification of thrust areas for Research and Development by IITs, completion of research projects within the sanctioned grants and timelines, achievement of targets for publications, citations, conferences and faculty-wise targets and achievements there against to graduate Ph.D students etc., during the audit period 2014-15 to 2018-19. Significant audit findings are discussed in subsequent paragraphs.

### 5.4.1 Sponsored Research Projects

The DPR envisaged that the new IITs would have a strong sponsored research activity. IITs receive funds from both government and non-government/industry sources for Sponsored Research Projects and faculty members of the IITs are actively engaged in these. Research projects are sponsored by different funding agencies like DST<sup>29</sup>, CSIR, DRDO etc. During 2014-19, the eight IITs had executed 1,712 Research projects with an outlay of ₹857.71 crore.

Some of the areas of research included 5G Research and Building Next Gen Solutions, Mobile sensor network technologies, metal additive manufacturing, artificial intelligence, bio-inspired engineering, catalysts, energy and health care.

It was observed that all the eight IITs attracted sizeable funding from Government sources like DST etc. However, the number and cost of non-government sponsored projects in all IITs was low. It was noticed that IIT Mandi, IITP, IIT Ropar and IITH were able to attract between 3.5 to 14.31 *per cent* of total non-government funding among the eight IITs while the others attracted very low levels of funding.

As per the responses received through Ministry (September 2021), IITBBS and IITGN replied that they would continue with efforts to attract more non-government funding/industry sponsored projects. IITI replied that due to various efforts the number has increased to five research projects in FY 2020-21. IIT Mandi replied that it would be ensured to attract funding from non-government sources.

IITs being premier engineering and research Institutes, may take effective measures to attract substantial funding from non-governmental sources to develop research and technology-oriented environment by tying up with industry partners through MoUs.

<sup>29</sup> Department of Science and Technology (DST)

#### 5.4.2 Patents filed and obtained

As per the Patents Act, 1970, patent is granted for an "invention" which means a new product or process involving an inventive step and capable of industrial application.

As per Para 7.1 of Kakodkar Committee Report, one of the key roles of IITs should be of driving innovation and entrepreneurship, which result in patents and publications - the traditional measures of performance of faculty and research institutions.

The details of patents filed by the eight IITs for the period 2014-19 are as detailed in the *Table 5.7*:

**Table 5.7: Statement showing details of patents filed by the eight IITs**

Name of the IIT	IITBBS	IITGN	IITH	IITI	IITJ	IIT Mandi	IITP	IIT Ropar
Patents filed	18	19	94	44	28	35	31	30
Patents obtained	0	0	16	0	4	0	0	2

During the audit period, IITH filed 94 patents, followed by IITI, IIT Mandi, IITP and IIT Ropar. However, there was a large variance between the patents filed and obtained by the eight IITs which needs to be reviewed at highest level. In five IITs viz. IITBBS, IITGN, IITI, IIT Mandi and IITP, no patents were obtained during the five-year period indicating that the research activities could not bring out fruitful results.

As per the responses received through Ministry (September 2021), IITBBS replied that it expects that most of these patents filed would be cleared in coming days. IITGN replied that subsequently two patents have been granted and decision of grant of rest applications is expected in due course. IITI replied that the Institute has been granted seven patents for its inventions. IITP replied that as on date a total of five patents have been granted against the 42 applications filed and remaining applications are in various of stages for grant of patent. IITH, IITJ and IIT Ropar did not offer any specific comments.

The fact remains that for the period 2014-19 there was a large variance between the patents filed and obtained by the IITs.

#### 5.4.3 Research Publications

The DPR for the new IITs envisaged that the new IITs should establish a strong reputation of research through publication record of its faculty and students. Strong emphasis should be placed on publishing the results of research activities in international and national journals. The degree of excellence will depend on the publication record of students and the faculty. Further, the number of research publications is one of the metrics used in NIRF<sup>30</sup> which decides the performance of the higher education institutes and their ranking.

Publications made by the IITs during 2014 to 2019 is shown in *Table 5.8*:

<sup>30</sup> National Institutional Ranking Framework

**Table 5.8: Research publications by eight IITs**

Name of the IIT	IITBBS	IITGN	IITH	IITI	IITJ	IIT Mandi	IITP	IIT Ropar
No. of Publications	1844	1368	2230	3081	606	1427	1350	412
Average per faculty	3.12	3.10	2.64	6.42	1.85	3.03	2.61	2.56

Audit observed that in IITI (6.42) the average publications per faculty was highest, whereas in IITJ (1.85) the average publications per faculty was found to be lowest. In the remaining IITs, the average ranged between 2.56 and 3.12.

As per the responses received through Ministry (September 2021), IITBBS replied that it is encouraging the faculty to carry out more research work and publish more research papers and as a result, the number of publications increased from year to year. Remaining IITs did not provide any specific replies in this regard.

The fact remains that the IITs were lagging behind in the publication of research papers, which was a major focus area for the IITs.

#### 5.4.4 Ph.D students graduating per faculty

In order to produce more number of Ph.D students graduating from the IITs every year, Kakodkar Committee recommended that the IITs quickly get 0.6 Ph.D student to graduate for each faculty member every year and then strive to get to one Ph.D student to graduate per faculty each year in the years to come.

Audit, observed that most of the IITs have not achieved the desired average of 0.6 Ph.D graduates per faculty despite being established over a decade as shown in the *Table 5.9*:

**Table 5.9: Statement showing achievement of average number of Ph.D graduate per faculty in all eight IITs in AY 2018-19**

Name of the IIT	Number of Faculty members	No. of Ph.D graduations	Average Ph.D graduated per faculty
IITBBS	137	32	0.23
IITGN	100	24	0.24
IITH	197	69	0.35
IITI	127	83	0.65
IITJ	91	4	0.04
IIT Mandi	119	29	0.24
IITP	119	40	0.34
IIT Ropar	161	24	0.15
<b>Grand Total</b>	<b>1051</b>	<b>305</b>	<b>0.29</b>

Only IITI was able to achieve the prescribed 0.6 Ph.D graduations per faculty during Academic year 2018-19. IIT Ropar (0.15) and IITJ (0.04) remained far behind the desired ratio.

As per the responses received through Ministry (September 2021), IITBBS replied that owing to increase in enrolment of more students into Ph.D courses, the numbers would increase in coming years. IITGN replied that it had achieved ratio of 0.53 and 0.78 graduate per faculty respectively during 2020-21 and 2021-22. IIT Mandi, IITP and IITH replied that efforts are being made to increase in the number of registrations in Ph.D programmes.

As could be seen from the replies, the IITs have indicated that more efforts are being put in the coming years to increase enrolment of Ph.D candidates. This needs close monitoring by the MoE to ensure that the objective of more number of Ph.D students graduating from IIT system is achieved.

#### **5.4.5 Non-Establishment and functioning of Research and Technology Development Council**

MoE's DPR envisaged establishment of a Research and Technology Development Council in the governing structure of each IIT, to provide policy guidance for research and development activities. Audit observed that no such Council was established by the IITBBS, IITH, IITI and IITP during the period 2014-19. As a result, the policy guidance from a specialised body for research and development activities was lacking.

As per the responses received through Ministry (September 2021), IITBBS replied that no specific instructions in this regard were received from Ministry and that R&D activities were being regularly monitored by the Dean (R&D) and reviewed by the Director. IITH replied that the establishment of Research and Technology Development Council was at planning stage. IITI replied that they are formulating a committee to setup a road map for technology transfer and related activities and IITP replied that it had subsequently constituted an Institution's Innovation Council (IIC).

The fact remains that establishment of research councils for initiating and promoting research at Institute level was still in nascent stages in most of the IITs. This impeded the necessary thrust required to be given to the pace of R&D activities in the IITs.

#### **5.4.6 Adherence to timelines in progress of Research Projects**

Audit test-checked 208 sampled cases of research projects in eight IITs for assessing the cost and time over runs. Out of 189<sup>31</sup> projects for which information was provided to Audit, 96 projects were scheduled to be completed by March 2019. Out of these, Audit observed delays in 17<sup>32</sup> research projects (18 *per cent*) in six IITs (IITBBS, IITH, IITJ, IIT Mandi, IITP and IIT Ropar) with delay ranging from 22 days to 644 days as of March 2019.

As per the responses received through Ministry (September 2021), IITBBS replied that all efforts are being taken to complete the projects within the said period/extended time. IITH replied that there were delays in completion of projects due to fund flow issues. IITJ attributed the delay to non-working of equipment, incomplete data set, non-response from funding agency etc. IIT Mandi replied the delay was attributable to fund flow issues,

<sup>31</sup> Out of 208 sampled cases complete data was not provided by IITs for 19 cases.

<sup>32</sup> 8 completed, 9 in progress

remoteness of the area. However, the IIT Mandi added that whenever there is delay in completion of the project, a request with valid reasons was made to the funding agency for grant of extension for completion. IITP replied that time overrun always has the concurrence of funding agency and has no negative impact on the final outcome of the project. IIT Ropar did not offer any specific reply.

The replies are not tenable for the reason that the IITs have to plan and execute research projects taking all the issues into consideration. Inordinate delays in completion of research projects would result in non-achievement of intended objectives.