CHAPTER EIGHT

IIT EDUCATIONAL SYSTEM

"The teacher who walks in the shadow
of the temple, among his followers,
gives not his wisdom but rather
of his faith and his lovingness.
If he is indeed wise he loves not bid you
enter the house of his wisdom, but rather
leads you to the threshold of your own mind".

Kahlil Gibran
(1883-1931)

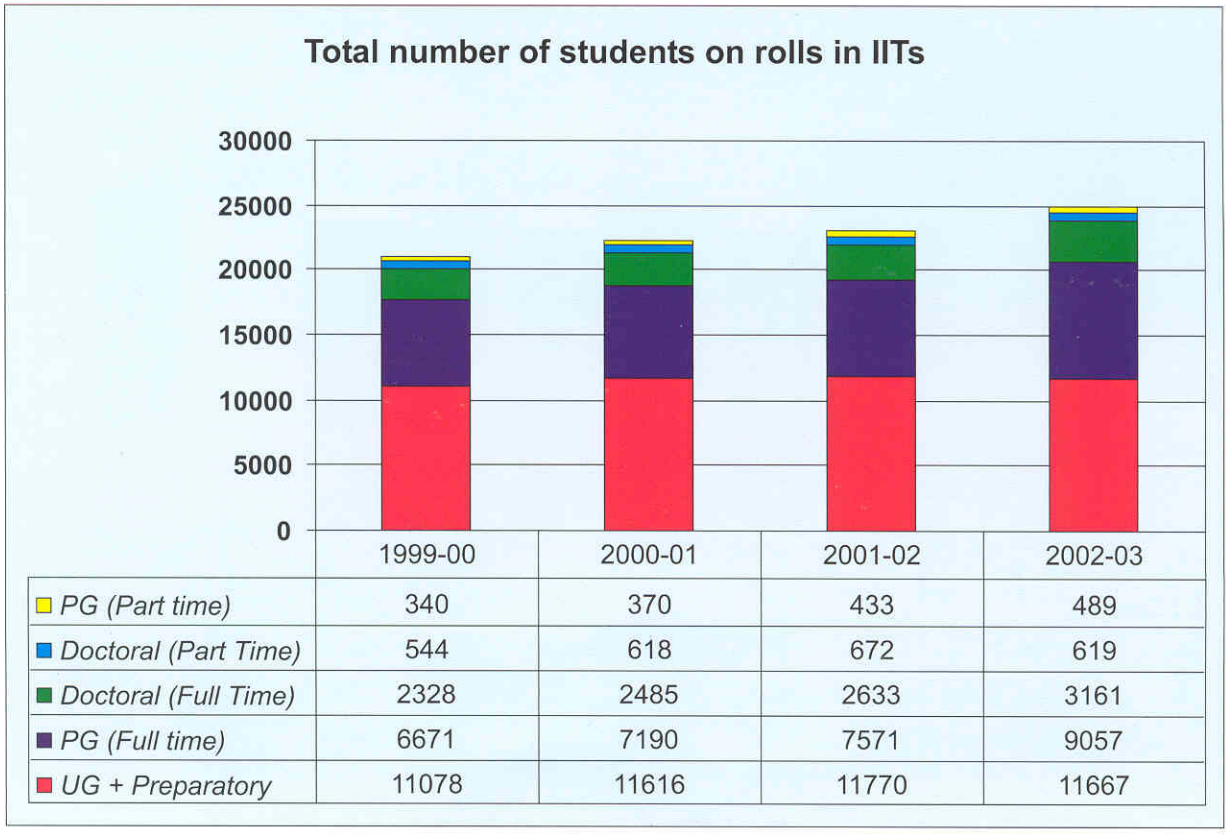
CHAPTER EIGHT

IIT EDUCATIONAL SYSTEM

It is widely acclaimed that the IITs offer high quality education. In particular, the Bachelor of Technology (B. Tech.) degree of the IITs is one of the few products of the educational system of India that is acclaimed worldwide and the brand name that the IITs have earned is largely due to the performance and achievements of their B.Tech. graduates. However, as past experience with commercial brands has shown, unless periodic reviews and, thereby, retuning is carried out to improve the product, its value tends to diminish over a period of time. Also, the brand name must extend to their M.Tech. and Ph.D. products. This chapter analyses the data pertaining to the students at UG, PG and Ph.D. levels and suggests possible improvements.

8.1 STUDENTS ON ROLLS DURING 1999-2003

Figure 8.1 shows the students on rolls in the IIT system over the past four years. The following trends in the growth in student strength during these four years are notable:



	1999-00	2000-01	2001-02	2002-03
PG (Part time)	340	370	433	489
Doctoral (Part Time)	544	618	672	619
Doctoral (Full Time)	2328	2485	2633	3161
PG (Full time)	6671	7190	7571	9057
UG + Preparatory	11078	11616	11770	11667

Figure 8.1: Total number of students on rolls in the IITs

- The total number of students on rolls in the IITs increased by 19% from 20,985 to 24,993 (about 4000 in four years). While the UG strength increased only by about 5%, the PG strength increased by over 30% and the Ph.D. student strength increased by over 25%.

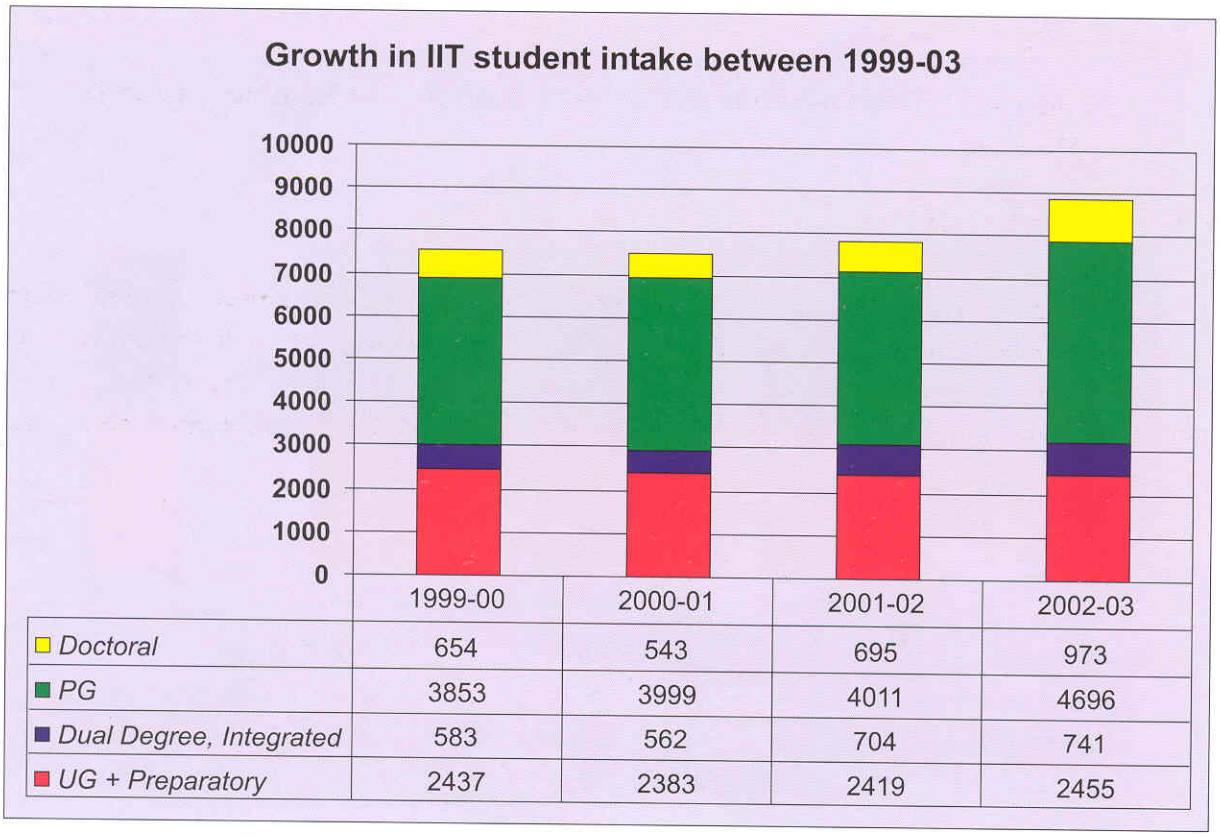
- The (Ph.D.+PG):UG ratio increased from 0.89 to 1.14. On campus, the UG strength, in comparison to PG+Ph.D. strength, appears to be decreasing. This trend may alter the campus climate.

- Part-time students (PG and doctoral) account for 6% of the total students on rolls, with the remaining situated on campus. This points to the campus centric model of IITs. Proximity of students and faculty is a key factor influencing the IIT brand.

- The average student strength per IIT is about 3570.

8.2 STUDENT INTAKE DURING 1999-2003

Figure 8.2 shows the change in student intake over the last four years. The growth in intake over the 4 year-period has been about 18%. This is the same as the growth in the number of students on rolls.



	1999-00	2000-01	2001-02	2002-03
Doctoral	654	543	695	973
PG	3853	3999	4011	4696
Dual Degree, Integrated	583	562	704	741
UG + Preparatory	2437	2383	2419	2455

Figure 8.2: Growth in IIT student intake between 1999-03

Highest growth has been in Ph.D. intake (49%), followed by Dual Degree (27%) and PG (22%). Growth in UG intake has been 0.7%. In absolute terms, the number of PG intake exceeds the UG intake. **The UG brand, which has achieved international recognition, is not being scaled up although there is no shortage of quality students for UG programmes.**

- UG intake: There is sufficient number of quality students to increase intake for UG programmes by 3-4 times the current capacity. In 2003, nearly 1.8 lakh students appeared for IIT JEE. The number selected was about 3750 including those admitted to BHU-IT and Dhanbad ISM (selectivity for the IITs <2%). It is estimated that another 5-7% of students taking JEE would be suitable. That means that the UG strength in the IITs can go up to 17000, in principle, from the present ~11500 without any dilution in the quality of admissions.

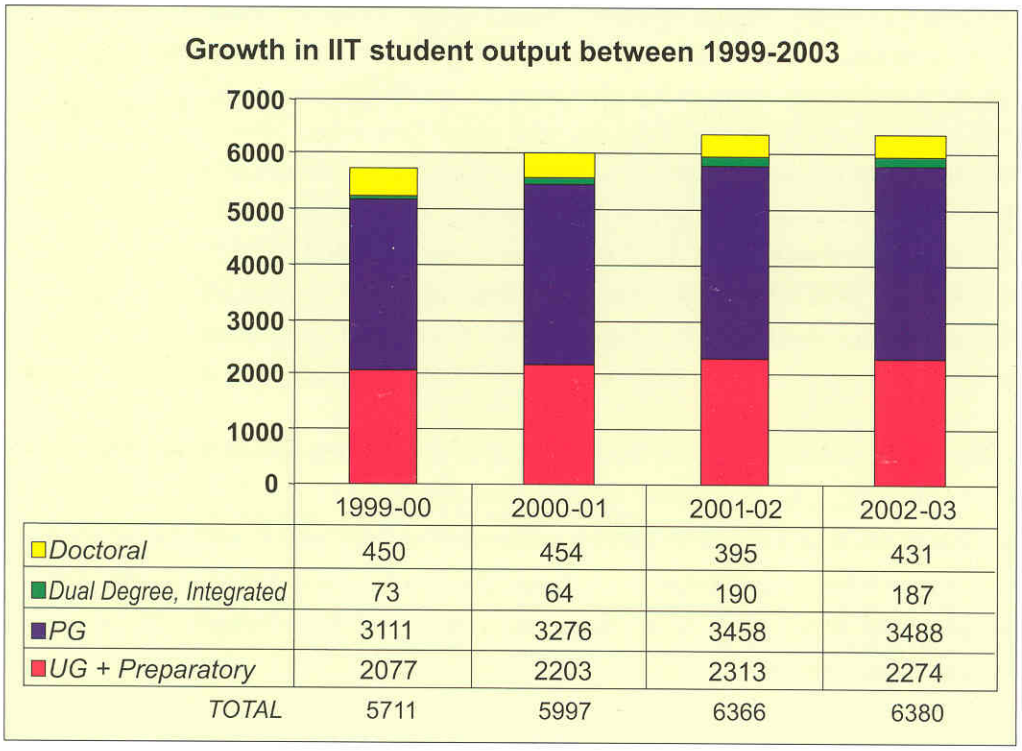
- PG Intake: In 2003, about 1.59 lakh students (out of 3.5 lakh engineers produced by the country) appeared for GATE. The number of qualified candidates was 28,877 (selectivity = 18%). Recall that the JEE is rated as a much tougher examination at the 10+2 student level, as also that the selectivity for admission has been only about 2% in UG. By comparison, the quality of PG students admitted is not likely to be as good. The rise in PG strength should not be taken, therefore, at its face value.

- It is hard to comment on Ph.D student selectivity, as they are not taken in by a single mechanism like JEE. The drop-out in Ph.D., in particular, is quite large.

- **The number of IIT B.Tech.s opting for PG and Ph.D. programmes in the IITs is worryingly small !**

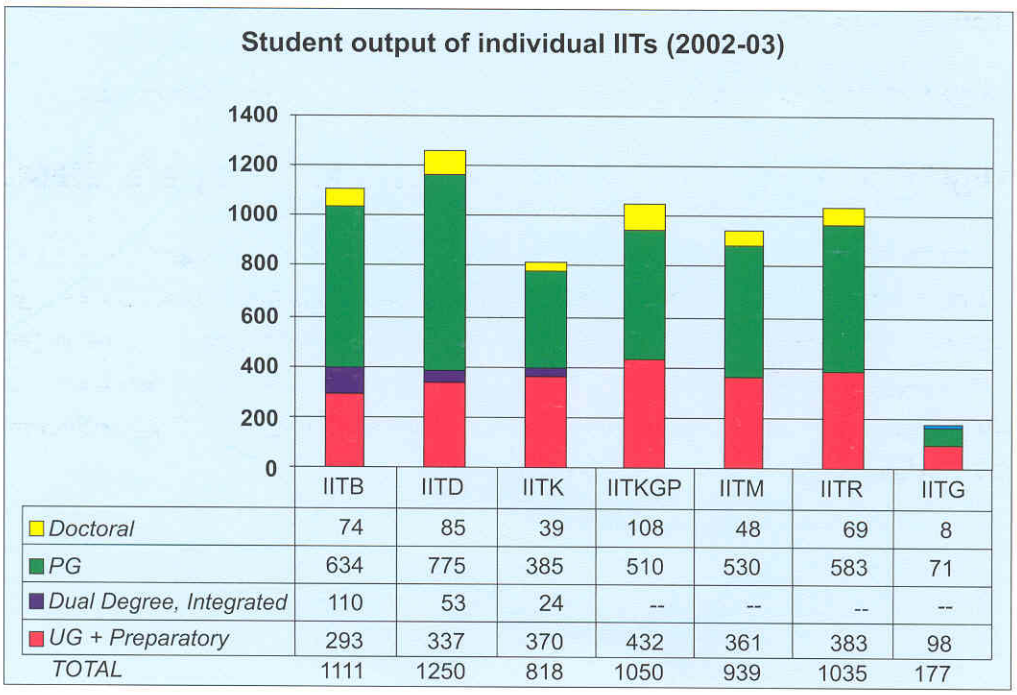
8.3 GRADUATE OUTPUT

The growth in student output during the 4-year period has been only 11.7% (Figure 8.3), considerably less than the growth in the student intake (19% as shown in Figure 8.2). While the out-turn of Ph.Ds has remained stagnant, the out-turn of PGs (M.Tech. + Dual Degree) has risen by 15.4%. The growth in UG output has been even lower at 9.5%. However, there are differences across IITs (Figure 8.4).



	1999-00	2000-01	2001-02	2002-03
Doctoral	450	454	395	431
Dual Degree, Integrated	73	64	190	187
PG	3111	3276	3458	3488
UG + Preparatory	2077	2203	2313	2274
TOTAL	5711	5997	6366	6380

Figure 8.3: Growth in IIT student output between 1999-2003



	IITB	IITD	IITK	IITKGP	IITM	IITR	IITG
Doctoral	74	85	39	108	48	69	8
PG	634	775	385	510	530	583	71
Dual Degree, Integrated	110	53	24	--	--	--	--
UG + Preparatory	293	337	370	432	361	383	98
TOTAL	1111	1250	818	1050	939	1035	177

Figure 8.4: Student output of individual IITs (2002-03)

8.4 KEY FEATURES & POSSIBLE IMPROVEMENTS IN THE EDUCATION SYSTEM

We have here assembled key features of the educational system of the IITs. From such a PAN-IIT consideration, certain aspects requiring focused attention arise. These are:

(i) Degrees offered and the Disciplines in which they are offered

(ii) Number of Courses offered by each Institute

(iii) Definition of Credit and Credit Requirements for B.Tech. and M.Tech. Dual Degree

(iv) Science and Humanities & Social Science Components in the B.Tech. and M.Tech. Dual Degree programmes

(v) Research component in the B. Tech. Degree Programme

(vi) Continuation of the M.Tech. Dual Degree Programme?

(vii) Introduction of a New 4 year B.Tech. programme for B.Sc. graduates

(viii) Undergraduate Courses in Science in the IITs

(viii) Academic Units in the IITs

(ix) Continuing Education Programme

We will take up each of the above items and see what improvements may be possible.

8.4.1 Degrees offered and the Disciplines in which they are offered

Table 8.1 shows the different types of degrees offered by the IITs. The number appears to be large and with a little effort it can be rationalized to a more meaningful list. Just to give a few examples, the B. Design can be renamed B.Tech. (Design); the Master of Management, Master of Business Management and Master of Business Administration offered at different IITs can have a common nomenclature. The P.G. Diploma can be renamed as D.IIT like the D.IIT being conducted for the Navy in IITD and for Video Communication in IITK.

Table 8.1: Total number of Degrees offered

Degree	No. of Disciplines						
	IITM	IITD	IITG	IITK	IITKGP	IITB	IITR
B.Tech.	10	9	6	8	16	8	9
B. Arch.	-	-	-	-	1	-	1
B. Des.	-	-	1	-	-	-	-
M.Sc. (5 year Integrated)		-	-	3	5	1	-
M.Sc. (2 year)	3	3	3	4	5	6	6
M.Tech. Dual Degree	13	5	-	6	15	7	3
M.Tech.	26	36	4	13	46	16	38
Integrated M.Tech.	-	1	-	-	-	-	-
M. Des.	-	1	-	1	-	-	-
M. Arch.	-	-	-	-	-	-	1
M.S. (Research)	10	6	-	-	-	1	-
M.Phil.	-	-	-	-	-	1	2
M.B.A	1	3	-	1	-	-	1
Master of Management	-	-	-	-	-	1	-
M.B.M	-	-	-	-	1	-	-
M. Medical Sci.& Tech.	-	-	-	-	1	-	-
M. City Planning	-	-	-	-	1	-	1
D.I.I.T.	-	1 (for Navy)	-	1 (Video Comm.)	-	-	
P.G. Diploma	-	-	-	-	2	-	7
Ph.D.	13	26	11	18	30	21	19
M. Sc.– Ph. D. Dual Degree	-	-	-	1	-	-	-
Integrated Ph.D.	1	-	-	-	-	-	-

Table 8.2 shows that there also exists scope for rationalization of the disciplines in which the degrees are offered. Just as an example, B.Tech. degree is offered in Materials and Metallurgical Enginneing in IIT Kanpur, while Metallurgical and Materials Engineering is offered in IIT Madras, IIT Kharagpur and IIT Roorkee. The disciplines bracketed in Table 8.2 may also be seen in this context.

In regard to the Masters courses as well, there is similar scope for rationalisation (PG admission brochures of the IITs may be referred to for the full list of disciplines).To cite one example, there are two 5 year M.Sc. Integrated courses, one in Mathematics and Scientific Computing (IITK) and another in Mathematics and Computing (IITKGP). In addition, there is a 5 year Integrated M.Tech.course in Mathematics and Computing (IITD).

A common nomenclature for B.Tech., as well as Masters courses, can be arrived at to avoid the impression that each of these disciplines offers something very distinct.

Table 8.2: Disciplines in which B.Tech. Degree is offered (including B. Design)

Discipline	Degree Offered						
	IITM	IITD	IITG	IITK	IITKGP	IITB	IITR
Aerospace Eng.	•		•	•	•		
Agriculture and Food Eng.					•		
Biotechnology and Biochemical Eng.					•		
Biotechnology	•		•				
Chemical Eng.	•	•	•	•	•	•	•
Civil Eng.	•	•	•	•	•	•	•
Computer Sci. & Eng.	•	•	•	•	•	•	•
Design			•				
Electrical Eng.	•	•		•	•	•	•
Electrical Eng. (Power)		•					
Electronics & Communication Eng.			•				•
Electronics & Electrical Comm. Eng.					•		
Energy Eng.					•		
Engineering Physics*	•	•				•	
Industrial Eng.					•		
Production and Industrial Eng.		•					•
Instrumentation Eng.					•		
Manufacturing Sci. & Eng.					•		
Mechanical Eng.	•	•	•	•	•	•	•
Materials & Metallurgical Eng.				•			
Metallurgical & Materials Eng.	•				•		•
Metallurgical Eng. & Materials Sci.						•	
Mining Eng.					•		
Naval Architecture & Ocean Eng.	•						
Ocean Eng. & Naval Architecture					•		
Pulp & Paper Eng.							•
Textile Technology		•					

* In essence this is an undergraduate science degree.

8.4.2 Number of Courses offered by an IIT

Table 8.3 shows the number of courses offered by each institute at the undergraduate (UG) and post-graduate (PG) levels every year. The number varies for the different IITs depending upon the number of departments and programmes offered by the individual IIT. It has been indicated that not all the courses are offered in any given year. **Analysis of the list of courses in the IITs suggests that a reduction in the number of courses would be possible through rationalisation of obsolete courses and consolidation of overlapping courses** (for example, Finite Element Methods, Fluid Mechanics, Heat and Mass Transfer and Advanced Engineering Thermodynamics) **offered in the different departments in each institute.** This would release more time for the faculty for research and other more creative activities. If research (including research based teaching) has to occupy primacy, every aspect of the IIT teaching load has to be examined from the viewpoint of getting them more time and energy for research.

Table 8.3: Total number of Courses offered in a year

	UG	PG	Total
IITB	533	552	1085
IITD	639	829	1468*
IITG	340	130	390**
IITK	425	334	759
IITKGP	1437	1540	2977^
IITM	503	542	1045
IITR	422	950	1372

* 210 courses are common between UG and PG

** 80 courses are common between UG and PG

^ All possible electives are considered

8.4.3 Definition of Credits for B.Tech. and M.Tech. Dual Degree

Considering that, in the mind of the public, IITs constitute one educational system of high brand value and visibility, and that admissions are made through a common entrance examination (JEE), it is logical to expect that this system functions by certain common guidelines so far as organisation of certain basic elements are concerned. While this is largely so, definition of a credit and the credit requirements for the award of B.Tech. and M.Tech. Dual Degrees show differences. This is illustrated in the analysis of the credit requirements for the B.Tech. and M.Tech. Dual Degrees presented in Tables 8.4 and 8.5. One major reason for this is that the definition of a credit in IIT Mumbai and in IIT Guwahati is different from that in the other IITs. IITs should consider having a uniform definition of a credit, as indeed 5 of the 7 IITs do have (1 credit for 1 hour Lecture or 1 hour Tutorial or 2 hours of Laboratory, all per week).

Table 8.4: Credit requirements for B.Tech. Degree

Subjects	No. of Credits						
	IITM	IITD	IITG^	IITK**	IITKGP	IITB^	IITR
Basic Science	31	20 min	64	35 (28)	24	62	27
Humanities	12	15	30	15 (16)	14	18	16
Professional Courses including Departmental Electives	93	90	155 ±	90 (90)	73-81	213	102-110
Engineering Science	15	20 min	40 ±	20 (10)	27	—	35
Non-Departmental Compulsory Subjects and Electives	18	25 min Typically 31-35	36 ±	-	15	12	12
Projects + Practical Training	11	10-13*	28 ±	(15)	12	20	14*
Others	-	-		(9) (Tech. Arts)	-	-	14 (Extra Curr.)
Total	180	180	340-360	180(168)	165-173	325	206-214

* These credits are included in the credits for Professional Courses
^ The method of calculation of credits is different from that of the other five IITs
** The figure in the bracket indicates the credits for 2004

Table 8.5: Credit requirements for M.Tech. dual Degree

Subjects	No. of Credits						
	IITM	IITD	IITG^	IITK**	IITKGP	IITB^	IITR
Basic Science	31	20 min	-	39 (28)	24	62	27
Humanities	12	15	-	25 (16)	14	18	16
Professional Courses including Departmental Electives	87	78-80	-	90 (90)	99-109	235	94-102
Engineering Science	15	20 min	-	20 (10)	31	--	35
Programme Core	19	48-50	-	36-40 (32)			16-24
Non-Departmental Compulsory Subjects and Electives	18	25 min Typically 31-35	-		12	12	12
Projects + Practical Training	20	20-23*	-	(32)	37	108	40-44
Others	8	-	-	(14) (Tech. Arts)	-	-	14 (Extra Curr.)
Total	210	180	-	216-220	217-227	435	254-270

* These credits are included in the credits for Professional Courses
** IIT Guwahati does not offer M.Tech. Dual Degree
^ The method of calculation of credits is different. Two credits here correspond to one credit in other IITs

8.4.4 Science Component in the B.Tech. and M.Tech. Dual Degree

The break-up of the credit requirements of the B.Tech. and M.Tech. Dual Degree programmes (Tables 8.4 and 8.5) shows that the Science component ranges from 11 to 19 % of the total credit requirement. The Science (including mathematics) content of the earlier five-year B.Tech. programme was about 20 to 25 % of the total credit requirement. Thus, the Science content in the IIT Engineering curriculum has undergone a reduction after the transition from the five-year to the 4 year B.Tech. programme. Modern engineering developments are increasingly being triggered by advances in science and by the use of mathematical approaches. Consequently, modern engineering education will have to be more and more science based. Professor Dutta Roy of IIT Delhi in his article in Current Science [Volume 78, No.10, 25 May, 2000, p 1183 - 84] has succinctly brought out the importance of science in the engineering curriculum. As he aptly puts it, it is essential to increase the science content in order to motivate and prepare bright graduates for engineering design, research, development and innovation. Emphasis on science and enhancing its content in the IIT B.Tech. and M.Tech. credit composition needs to be given serious and urgent attention.

For the admission test (JEE), the composition of basic subjects has included only Physics, Chemistry and Mathematics; Biology has not been a component so far. In making this observation, the introduction of Biotechnology in the IITs is set aside, which is a separate issue, albeit a welcome development. **Considering the emergence of Biology as a key field in recent years and its links to biotechnology, bioinformatics, artificial intelligence, neural networks, genetic engineering etc., it has become essential to accord a place for biology alongside Physics, Chemistry and Mathematics in the IIT B.Tech. programme.**

8.4.5 Humanities and Social Sciences (HSS) Component

The break-up of the credit requirements of B.Tech. and M.Tech. Dual Degree programmes (Tables 8.4 and 8.5) also shows that the Humanities and Social Science (HSS) component ranges from 6 to 9% of the total credit requirement. The five-year to four-year transition has had its negative effect on the HSS component as well.

Several employers have observed that the communication skills and societal awareness of the four-year B.Tech. graduates are not commensurate with their technical skills. The importance of reversing this trend cannot be overemphasized. Ignoring the importance of HSS education can place at risk technical leadership that is increasingly graining prominence, within our own country and on the world stage. Language skills, genuine awareness of all that the term humanities comprises (also known as liberal arts) and the cultural-ethical dimension of our own country in a world-perspective are all to be assimilated at an impressionable age alongside technical education. It has become imperative, therefore, to re-examine the Humanities and Social Science component in the B.Tech. and M.Tech. curricula, including their contents.

8.4.6 Research Component in the B.Tech. Degree Programme

Having inducted a select lot, it seems imperative that they are exposed to a flavour of research at an early age. This step is likely to have a positive influence on those inclined to opt for a career in research, an important need of the hour for our country's competitiveness. When opportunities and encouragement are provided, even during the course of the B.Tech. programme, a bright undergraduate can come out with a creditable publication. If these were to happen frequently, it will contribute significantly to enhance the research culture on campus.

It would be most desirable to introduce credit-based project work in the 2nd year to be taken forward in the 3rd and the 4th years.

IIT Delhi (may be some others as well but not all IITs) is operating a non-credit Summer Undergraduate Research Activity (SURA) in which the students work out a research problem of their interest under the supervision of a faculty member. This is yet another mechanism to encourage research involvement in the undergraduates. In this context, **it should be heart warming to note the invariably excellent performance of the IIT undergraduates who take up summer fellowships awarded by the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. This latent research potential needs to be tapped in the IIT 4 year programme from an early stage as suggested.**

8.4.7 Continuation of the M.Tech. Dual Degree Programme?

Several senior academics have observed that the Dual Degree programme is constrained by the existing B.Tech. and M.Tech. programmes. There appears to be substance in their observation. The break-up of the credit requirements of the Dual Degree and B.Tech. programmes is provided in the (Tables 8.4 and 8.5). Notice that the number of credits for Science or for Humanities & Social Science (HSS) has remained the same in the two programmes. The original idea of restoring the 5 year science or HSS contents in the 5 year dual degree has not materialised. The only difference between the Dual Degree and B.Tech. appears to be a few extra P.G. courses and a larger Project work component in the 5th year of the former than in the B.Tech. course. This suggests that the Dual Degree programme by and large has not served a greater academic purpose (when compared to the 4 year B.Tech. + 2 year M.Tech. system) and may have incidentally facilitated the entry of lower ranked students who could not make it to the B.Tech. programme of their initial choice. There definitely is a case for redesigning the whole course or scrapping it altogether in favour of a new M.Tech. programme suggested below.

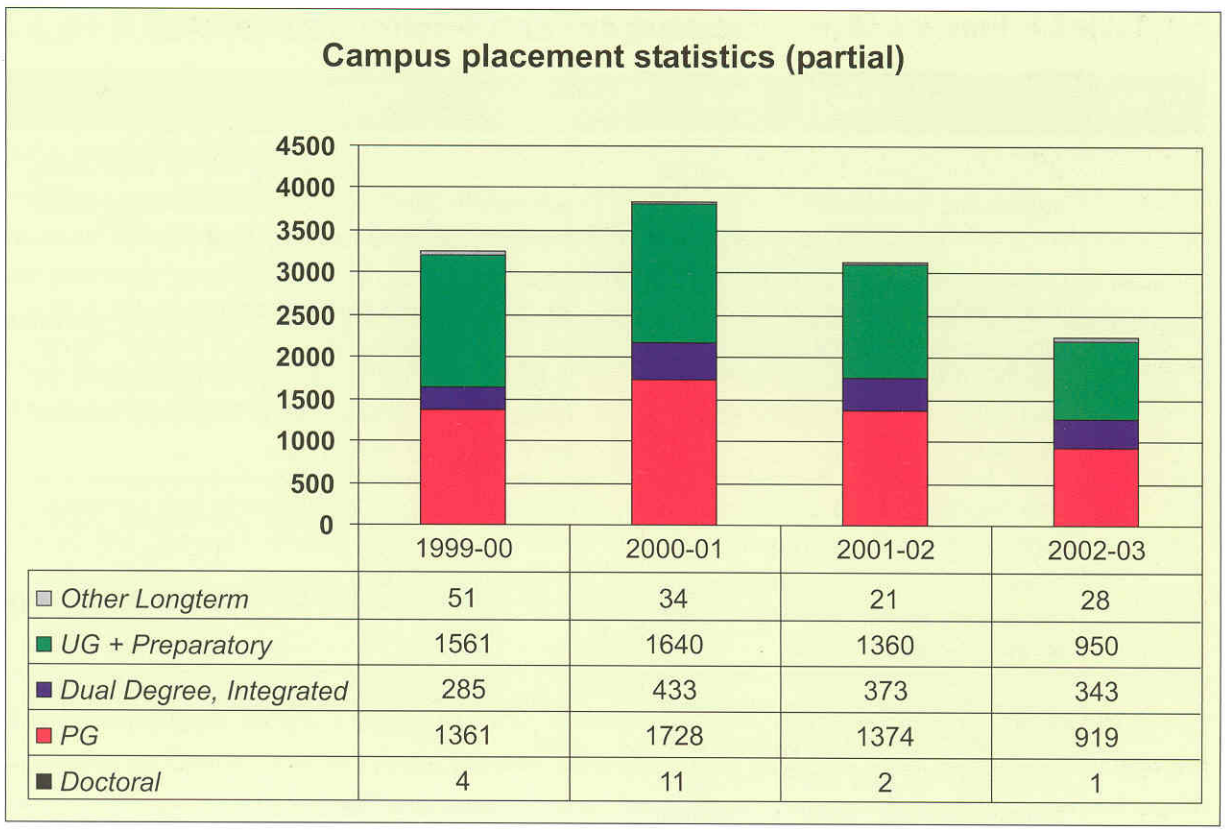
8.4.8 Introduction of a New 4-Year M.Tech. Programme for the B.Sc. Graduates

A better scheme could be to introduce a 4 year M.Tech. option for B.Sc. graduates. In our country, about 15-16 lakh B.Sc. students graduate every year. It is heart-rending to see them groping for good career prospects, with several of them ending up as technicians. A JEE type all India examination can be conducted to select the best say 1000 (about 150 in each of the 7 IITs at the rate of 30 seats in 5 such 4 year M.Tech. programmes). The selectivity for the M.Tech. admission could thus go up significantly. Improving selectivity in M.Tech. admission can be expected to make a significant difference to the quality of PG intake. The need for this exists since PG placement in campus interviews has been consistently below that of the UG placement (Figure 8.5).

Institutes with higher output (primarily due to higher PG output) show greater difference between UG and PG placement (Figure 8.6)! Greater proportion of UG students get placed compared to PG. This points to the widening gap between UG and PG quality, especially at higher outputs.

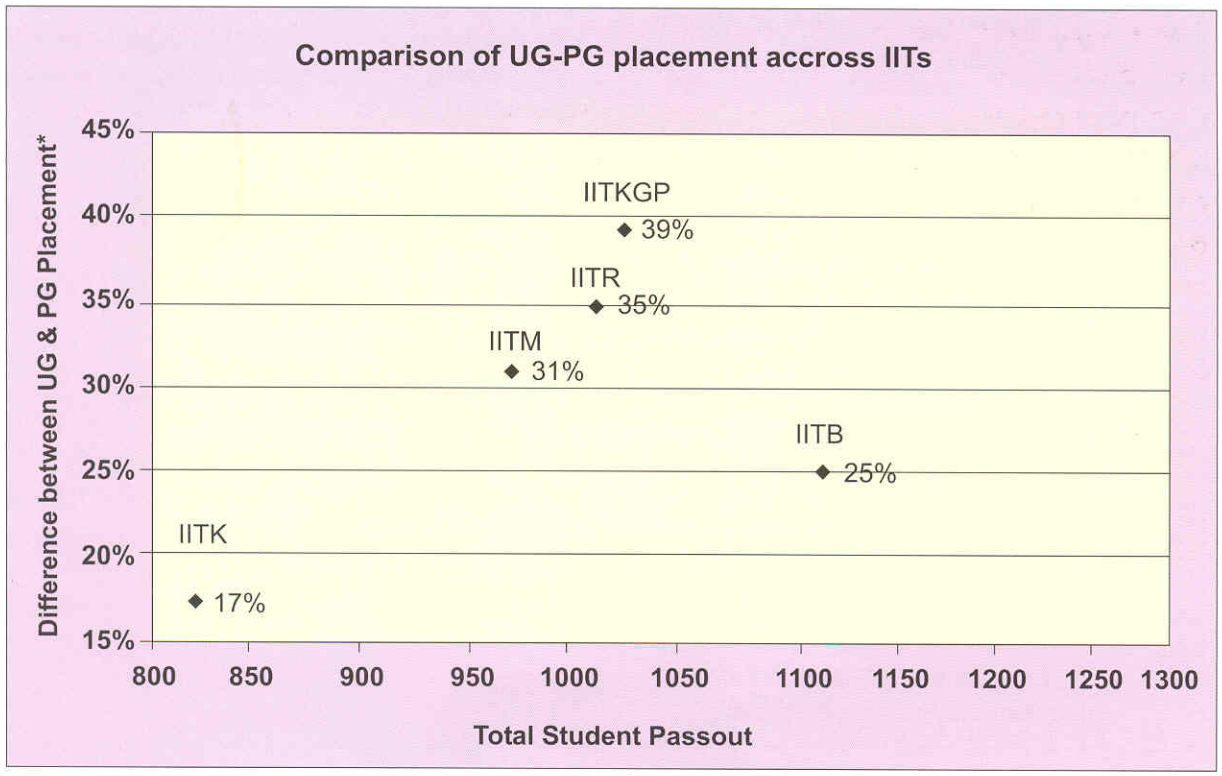
There is yet another notable point in favour of taking in the B.Sc.s, as suggested. These students would enter the IITs with a strong science base, whose value has been pointed out in the earlier paragraphs. Further, B.Sc.s with biology as their main subject would also see a new avenue for an engineering career. These graduates with their strength in science would be good material for pursuing an engineering research career and more.

The Indian R&D based industrial scene presents, as of today, an uneven picture. For example, chemistry and chemical engineering related industry has done significantly better than physics-based industry. Encouraging B.Sc.s to opt for M.Tech. in IITs would be a helpful measure for generating a greater number of well trained personnel with such composite background. This, hopefully, will add to the prospect of wider science and R&D based industry to grow and thrive in the country. (See Table 8.6 annexed for pros and cons of this suggestion).



	1999-00	2000-01	2001-02	2002-03
Other Longterm	51	34	21	28
UG + Preparatory	1561	1640	1360	950
Dual Degree, Integrated	285	433	373	343
PG	1361	1728	1374	919
Doctoral	4	11	2	1

Figure 8.5: Campus placement statistics (partial)



* %UG placed/UG passed out - % PG placed/PG passed out

Figure 8.6: Comparison of UG-PG placement accross IITs

Table 8.6: Pros and Cons of the proposed 4-year M.Tech. Programme after B.Sc.

Sl. No.	PROS	CONS
1.	B.Sc. level science base for potential engineering graduates	The social pressure of getting into an engineering programme after 10+2 could dilute to some extent the bright elements for this programme
2.	Will significantly improve the career prospects for the bright B.Sc.s among the 15-16 lakh graduates each year and offer IIT opportunity to late bloomers	To conduct a JEE type examination for the B.Sc.s will be additional burden on the IIT faculty. This has to be avoided. The solution will be to outsource the conduct of the examination to a carefully selected body with close monitoring.
3.	The brightest of the B.Sc.s can be picked up for the 4 year M.Tech. programme by designing and conducting a JEE type examination for the B.Sc.s.	Designing an appropriate 4 year M.Tech. curriculum, with a substantial project element, will be a challenging academic exercise.
4.	Selectivity in the M.Tech. admission, today being low at 15:1 (compared to better than 50:1 for the B.Tech.s.), is bound to go upto something comparable to B.Tech. selectivity.	Additional infrastructural requirement will have to be met.
5.	Will allow students with B.Sc. Biology to pursue a career in engineering	This will lead to scrapping the current 5 year Dual Degree programme as well as the integrated Masters programmes which may have lost their attractiveness. This becomes necessary to eliminate avoidable burden on the faculty.
6.	Most likely that B.Sc. + M.Tech. experience would encourage such engineering graduates to stay in research which is essential for advanced technology programmes. More such well trained personnel would be a resource for science and R&D based industry.	
7.	The trauma of not getting into the IIT system in those large numbers failing to make the required JEE grade will be mitigated to a significant extent.	
8.	The success of the 4 year M.Tech. programme is likely to have a positive impact on the quality of B.Sc.s. in the country.	

8.4.9 B.Sc.s for Integrated Ph.D. Programme.

There could be another good use for the suggested JEE type examination for the B.Sc. students. IITs could introduce an integrated Ph.D. programme in science, engineering and interdisciplinary areas for the carefully selected B.Sc. students. The Indian Institute of Science has introduced such an integrated Ph.D. programme for the B.Sc. graduates who are carefully selected. The IISc Ph.D. programme for the B.Sc. graduates is in the science subjects (Physics, Chemistry, Biology and Mathematics). Based on the happy experience with this experiment at the IISc, IITs could extend the concept to include Ph.D. in engineering subjects as well for select B.Sc. graduates.

The Committee considers suggestions made in sections 8.4.8 and 8.4.9 to be among its more important recommendations.

8.4.10 Undergraduate Courses in Science?

Undergraduate courses in science (B.Sc. courses) are conducted and managed in the country's numerous colleges (nearly 14000). In most of these colleges, research in basic science subjects is non-existent. Nor is there any room for educating the young students about application of science. There is no sign of a reform of this unsatisfactory situation. It has been suggested that it will signify a major corrective step if IITs decide to impart undergraduate science education alongside engineering education. The examples of MIT and CALTECH in USA are mentioned since the success of their products are attributable to science going together with engineering. Even though undertaking bachelors level science degree courses will require expanding the science departments in the IITs, the overall effort needed for this added programme may not be considerable. The Committee is recording this suggestion which demands a greater in-depth consideration. In this context, it may be noted that three of the IITs, namely IIT Mumbai, IIT Delhi and IIT Chennai, have recently started B.Tech. courses in Engineering Physics.

8.4.11 Academic Units

An analysis of the various academic units in the IITs (Table 8.7) indicates that they essentially consist of Departments and Centres. However, some IITs have introduced the concept of Interdisciplinary Programmes and/or Schools as distinct units. It is clear what constitutes a department. However, it is not clear when a unit is called a Centre, an Interdisciplinary Programme or a School in the IITs. There is also no consistency in the faculty strength in centres (Table 8.8).

Table 8.7: Total number of independent Units

IIT	Depts.	Centres	Schools	Int. Disci. Programmes
IITB	12	10	3	5
IITD	13	9	8	0
IITG	11	0	0	0
IITK	13	0	0	4
IITKGP	19	4	5	0
IITM	13	4	0	0*
IITR	18	4	0	0

Table 8.8: Faculty strength in Centres

	IITB	IITD	IITG	IITK	IITKGP	IITM	IITR
Faculty in Centres	24	118	0	8	39	0	32

IIT Delhi has evolved an organizational concept paper, which attempts to give precise definitions of the unit. This issue needs to be revisited by the IITs. **While doing so, IITs would do well to put into effect the trends in emergence of new disciplines.** Interdisciplinarity has yielded to borderlessness. **Breaking down of the compartmentalisation of disciplines has assumed importance.** Possibilities of flourishing new research directions at the interface between disciplines are being increasingly explored. The question then boils down to the following. **In what manner should one allow regrouping and coming together of disciplines so as to encourage research at potentially promising interfaces between subjects?** This is yet another academic challenge that needs to be addressed. **In addressing this challenge, the IITs would be well-advised to consider programme based academic structures, while perhaps retaining the Departments as administrative units.** Recently, IITM has developed 15 or so interdisciplinary programmes.

8.4.12 Continuing Education Programmes

Table 8.9 shows that the IITs conduct several short-term courses and Quality Improvement Programmes (the number ranging from 5 in IITG to 156 in IITB). There can be no two opinions about the importance of such courses. With faculty of the calibre that the IITs have, the general expectation is that they have a duty to help other institutions and industry personnel to raise their own standards. However, the following points are important in this context.

Table 8.9: Continuing Education Programmes (2002-2003)

IIT	Short Term Courses	Quality Improvement Programmes	Total
IITB	148	8	156
IITD	21	3	24
IITG	5	0	5
IITK	18	6	24
IITKGP	50	4	54
IITM	30	5	35
IITR	15	7	22

- The core function of the IIT faculty is to be engaged in advanced research and deliver advanced teaching courses. Other distractions have to be minimized if these core contributions have to be made at the highest academic level.

- The need for the above idea is accentuated when viewed in the context of the urgent necessity to impart momentum to advanced research in engineering and technology in the country.

- Engagement in continuing education programmes has to serve a larger purpose than merely training. Therefore, in this respect, IITs have to be involved with such industrial houses as are capable of adding significant assets to the IITs in the form of cooperative projects in new areas and in other ways (this has indeed happened in certain cases).

- The topics for the training courses and the target groups need to be chosen with incisive thinking so that there is value addition to the IITs as well, while the industry and other groups benefit from the IIT strengths.

- Continuing education programmes may be warranted where it serves a larger country or societal purpose.

- If a particular short term course does not meet the above criteria (or other such criteria arrived at by the IITs), they are best dropped from the IIT portfolio.

8.5 SUMMARY OF RECOMMENDATIONS

The main points brought out in this chapter are as follows:

(i) The nomenclature of the degrees could be rationalized, so also the disciplines in which the degree courses are offered at the B.Tech. and M.Tech. levels.

(ii) The definition of a credit attached to a given course may be revisited to avoid confusion that it may be causing to the outsiders, where there are differences among the IITs.

(iii) The total number of courses (B.Tech. + M.Tech.) appears very large. There is room for consolidation by exiting outdated courses and eliminating overlap.

(iv) The science and HSS content in the B.Tech. courses deserve to be enhanced.

(v) Research project (could be design centric or even business centric, besides basic research, depending upon the inclination of the student) should be introduced at the 2nd year stage to be taken forward through the 3rd year and 4th year of the 4-year B.Tech. programme.

(vi) The academic value of the 5-year dual degree programme should be reevaluated. Dropping this programme in favour of a new suggested M.Tech. programme deserves serious consideration by the IITs.

(vii) A new 4-year M.Tech. programme for the carefully screened in B.Sc. graduates has been recommended. A small number of select candidates from such screening process may be taken through an integrated Ph.D. programme.

The new M.Tech. programme cannot be introduced unless some of the others like the integrated Masters programme (integrated M.Sc and M.Tech. which may have in any case lost their attractiveness) are dropped. This will help IITs to consolidate essentially in terms of 4-year B.Tech., 2 year M.Tech. and the new 4-year M.Tech. for B.Sc.s, thereby easing the burden on the faculty, too.

(viii) The academic structure of the IITs may be freshly considered to achieve a shift towards programme based units.

(ix) The volume of continuing education programmes as well as the rationale for taking them up need a fresh look.

An attempt has been made here to offer a few suggestions, which in the Committee's view, will not only streamline the functioning of the IITs but also, in the long run, improve the quality of IIT education. It was not the objective of this Committee to attenuate the autonomy, which the IITs should continue to enjoy, but to look at various issues in a detached manner and in the context of the present trends. Eminent universities such as the University of Illinois, UC and the others have welcomed the observations made by a body such as ABET (Accreditation Board for Engineering and Technology) in the US. For the IITs, we do not envisage an externally formed committee. However, It is strongly suggested that a **PAN-IIT Committee of Academics** should be set up to give due consideration to the observations made here at the earliest. Decisions made thereby should be implemented expeditiously. Time is of the essence in the face of the galloping pace at which science and technology are undergoing changes in their texture.