Highlights of the Recommendations of the JAB Sub-Committee for Increasing Female Enrolment in B.Tech. in IITs

14th June 2017

The Sub-Committee

Chaired by Dr. Timothy A. Gonsalves, Director, IIT Mandi. 17 members and invitees participated in the meetings. About 40% of the participants were women faculty. This documents contains the highlights of the full report approved by JAB on 15th April 2017. The Appendix (pgs. 5-6) has the full list of recommendations.

The Context

Females proportionately:

in India (2011)	= 48.5%
+2 graduates (2010)	= 45%
in BE/BTech in India (2014)	= 28%
in BTech in NITs (2015)	= 22.1%
in PG in IITs (2016)	= 22.5%
in BTech in IITs (2016)	**= 8%**

In terms of numbers in 2016:

females joining engineering in India	= 3,00,000
females qualifying in JEE (Advanced)	= 4,570
females admitted to IITs	**= 848**

Evidently, there is interest in engineering among lakhs of women every year, there are enough qualifying in JEE (Advanced) to achieve a 45% gender ratio in IIT BTech, but a very small number are being admitted into IITs. The very low 8% in IIT BTech is a problem peculiar to IIT BTech.

Should We Care?

1. Engineers develop products and technology for the benefit of society. Women/girls form almost ½ of the society that uses our products and technologies. An engineering team that has strong members of various segments of society is more likely to have sensitivity to the needs of both halves of society.

2. Greater diversity of viewpoints in the classroom will result in better learning for all students. In Indian colleges, women are often found to be more sincere and hardworking than men. Hence, more women implies higher quality academics. We will be able to give a better education to our BTech students.

3. Today, with barely 8% females in BTech while females form 48.5% of Indian society, the IIT BTech is not serving the nation to the fullest. We are not giving education to almost half of the best young Indians.

For IIT BTech to retain its place as one of the best UG programmes world-wide, for IITs to stay at the forefront as technology leaders for the Nation, this situation must be redressed.

Causes

Several factors were identified as contributing to the problem. Important among these are societal biases (attitudes of parents, family, teachers, etc) and lack of sufficient role models.

1. Societal Biases: These biases result in much lower access to coaching, and the reality is that coaching plays a significant role in preparation for JEE (Advanced). The biases also limit the choices of female candidates during counseling – they often are allowed to opt only for a few branches in a few IITs near to their homes. If their ranks are not good enough for these, they are sent to NITs or private colleges.

2. Lack of Role Models: Given the very low number of women in IIT BTechs, schoolgirls who aspire to do engineering are unlikely to have any sisters/cousins/aunts/etc who did BTech in IIT to serve as role models. The very low admission rate of females in IIT BTech discourages young schoolgirls from trying for IIT, they would rather focus their attention on NITs and private engineering colleges where the success rate is much higher.

Experiments with JoSAA data

To decide on a seat allocation strategy and to validate its effectiveness, we have done simulations of a wide range of scenarios using real data from past JoSAA seat allocations. This data includes the rank lists with gender information, the choice lists of candidates, and the seat matrix. The simulations were done using the actual JoSAA seat allocation software (developed by IIT-K), modified to include seats earmarked for females. Hence, the results are realistic. Note: JoSAA is the body that allocates seats to IITs, NITs and a few other technical institutions.

We analysed candidates' choice lists to understand their preferences for various branches and institutions. We simulated different seat allocation strategies with/without extra seats and with/without seats earmarked for females. A number of scenarios were considered including addition of seats to all branches in all IITs, to a few select IITs, to a few select branches, etc.

Proposal

In 2016, 848 women were admitted to BTech in all IITs. In the range of JEE (Adv) marks of these candidates (excepting a few outliers), we find that there are about 1,400 women who did not join an IIT. This is mostly due to restricted geographical mobility imposed by their families or preference for specific branches. There is a further pool of 2,400 qualified women candidates who qualified in JEE (Adv) albeit with lower ranks.

Our proposal is two-pronged: (1) Immediately provide extra seats in IITs to accommodate some more of the 1,400+2,400 in IITs. (2) Provide incentives to motivate girls and their parents to prepare better for JEE (Adv) so that their ranks improve to the extent that they get admission to their preferred branches/IITs gender-neutral.

The IIT Council on 28/4/17 decided to target BTech female enrolment of 14% in 2018, 17% in 2019 and 20% in 2020. To this end, the Council approved 15 recommendations which fall under 3 categories:

Immediate effect: Kickstart the increase by adding supernumerary seats for women to make B.Tech. visibly a viable option for schoolgirls. Provide merit scholarships, prizes and other incentives.

Next few years: Target bright schoolgirls from 8th Std, motivate them towards IIT BTech, help them prepare for admission.

Long-term effect: Encourage societal change in various ways.

The IIT Council on 23/8/16 decided to collectively increase enrolment of all students from about 75,000 in 2016 to 1,00,000 by 2020. Construction of space and hiring of faculty for this increase is already underway. Our proposal will use only 3,500-5,000 out of the 25,000 additional seats for a few years. After that, with organic growth in the percentage of females admitted through gender-neutral, female supernumerary seats will no longer be needed.

Seat Allocation

Based on our extensive simulations and analysis, we have found one strategy that works. It is outlined here (for ease of understanding, details are omitted). Suppose an IIT has 1,000 sanctioned seats and nominally 80 (8%) females are admitted. The target for this year is say 14%, so we add 60 female supernumerary seats to result in 80+60 = 140 females admitted.

The seat allocation procedure follows these principles:

1. The number of male students admitted is not reduced, unless the overall performance of male candidates in JEE (Advanced) declines vis-a-vis females.

2. Rank-based merit is strictly followed within the pool of male candidates and within the pool of female candidates.

3. The increase in each IIT in a year may be more or less than the overall target depending on its capacity to handle additional students.

4. Statutory reservation for SC, ST, OBC and for PH is followed in the supernumerary seats as for the sanctioned seats.

Quality of the Intake

A criticism of preferential treatment for a disadvantaged group is that it dilutes quality. *We strongly refute this*. Admission of more women to IITs will not result in lowering of academic standards, even though some may have lower JEE (Advanced) ranks. On the contrary, the academic performance of the BTech batch is expected to increase.

1. Only female candidates who have qualified in JEE (Advanced) are considered. They are in the top 2% of all students admitted to engineering in India. Evidence such as Board exam results indicates that they are as meritorious as their male counterparts.

2. The ranks of females in JEE (Advanced) are lower due largely to systematic societal biases that deprive them of support for JEE (Advanced) preparation equal to that given to boys. Their lower ranks are not due to any inferior intellectual capability or in-

ferior schooling. They are no less meritorious than their male counterparts who have got higher ranks thanks to full parental support.

3. Many of the qualified females who did not join IITs have ranks in the same range as those who did join IITs. Our simulations with real JoSAA data show that with different scenarios of supernumerary seats, the closing marks of candidates admitted to each IIT are the same or only marginally lower than the baseline case.

4. A study done at IIT Delhi by R. Kaur and S. Banerjee compared the overall CGPA of male and female BTech students over 13 years (2003-2015). It was found that females consistently outperformed males by about 1 gradepoint on the average, despite their lower JEE/JEE(Adv) ranks.

Time Limit on Preferential Treatment

As schoolgirls and their parents observe that IIT BTech is a viable option for them, as they see more role models in IIT BTech, they will prepare more seriously for JEE (Advanced), similar to their male siblings and classmates. It is almost certain that with our proposed incentives, females will in a few years do better than male candidates in JEE (Advanced). The number getting admitted into the gender-neutral sanctioned seats will increase steadily. This *organic growth* requires a few years to become effective as interventions must be done from 8th Std onwards. Hence, the number of female supernumerary seats in each IIT is expected to decrease year by year after 2-3 years of operation of this scheme, and go to zero in 5-8 years.

Preferential treatment in admission and scholarships will be applicable in each IIT only until any one of:

1. a maximum time period of 8 years

2. the percentage of women in that IIT reaches 20% consistently over a period of 3 successive years (the scheme is a grand success)

3. it is found that over a period of 3 years the gender-neutral female percentage does not increase (the scheme is a flop)

When any one of these data-driven objective conditions are met, the termination of the scheme will be decided by JAB.

Appendix: Full List of Recommendations

Extracted from the Report dt. 12 Apr 17, Section 3.2

The committee recommends the following strategy:

1. **Kickstart higher enrolment**: immediately increase the number of women in BTech in IITs to serve as a role model for schoolgirls. Once parents see BTech in IIT as a viable option for females, they will drive and support their daughters also to excel in JEE (Advanced).

2. **Encourage early achievers**: identify high achievers amongh schoolgirls at say 8th Std, motivate them towards an engineering career, and provide them with systematic help in preparing for the highly competitive JEE (Advanced)

3. **Promote societal change**: provide counseling for parents, school teachers and schoolgirls in a variety of ways to change their mindset towards encouraging girls to aim for the top engineering colleges.

Step 1 is necessary to catalyse the process of attitudinal and societal change in Steps 2 and 3. For Steps 2 and 3 to be effective, there must be a critical number of women in each IIT. Given various factors such as the gender-based performance in School Board exams, gender-ratio in engineering seats in India, etc, the committee recommends 20% of the sanctioned strength as a minimum target to be achieved. Once this target is achieved, the increase of women in BTech in IITs will become organic.

In line with this strategy, the committee recommends the following short-term and long-term steps to address the problem.

A. Kickstart Higher Enrolment

Visibly and significantly increase the number of women students in BTech in IITs. They will serve as role models for bright schoolgirls. These schoolgirls and their parents will come to see IIT BTech as a viable option to strive towards.

1. Create a limited number of supernumerary seats for women in each IIT for a limited time until the number of women in BTech reaches 20% of the sanctioned strength in each IIT. Each IIT to steadily increase the gender ratio from the current 8-10% to reach 20% in 2-4 years. These supernumerary seats to be filled only by female candidates who have qualified JEE (Advanced).

2. All women students to be awarded merit scholarships regardless of parental income. Academic eligibility similar to MCM.

3. Prizes to be instituted in the Convocation, Institute Day, Foundation Day, etc for meritorious women students.

4. Reorient branches or start new branches that are more in tune with the aspirations and needs of women. E.g., "Chemical Engineering" could be renamed as "Chemical & Biomolecular Engineering".

5. In the time between declaration of JEE (Advanced) results and the start of counseling, each IIT to have a team to reach out to qualified female candidates to encourage them to fill in larger number of choices in the IIT system to increase their chance of

admission to IIT BTech. Girls and their parents could be invited to visit a nearby IIT for in-person advice.

6. Publicise women B.Tech. graduates and successful women engineers as role models in schools.

7. Preferential treatment in Items 1 and 2 above to be applicable in each IIT only for **EITHER** a maximum time period (say 8 years), **OR** until the percentage of women in that IIT reaches 20% consistently over a period of 3 successive years, **OR** if it is found that over a period of 3 years the nominal female percentage does not increase.

B. Encourage Early Achievers

Steps aimed at bright schoolgirls in the last few years of schooling to motivate them towards engineering and IIT BTech.

8. Identify girls from 8th Std onwards who have a high potential to excel as engineers. Mentor them systematically to motivate them for careers in engineering and to help them to prepare for admission to IIT. This would include online/in-person sessions during the school term and internships in IITs during the holidays.

9. Leverage the IIT-PAL scheme to improve the performance of schoolgirls in sciences.

10. On March 8th, International Women's Day, girls from schools in the region be invited to visit IITs and interact with students and faculty to raise their interest in B.Tech. programs of IITs

C. Promote Societal Change

Change the mindset that today limits the opportunities for girls to excel.

11. Every IIT to have a Women's Centre for generating awareness on gender issues and providing a forum for women students, faculty and staff.

12. Every IIT to have a Women in Science and Engineering (WISE) professional group. This provides a forum for women students to discuss their professional problems and aspirations, to organise competitions etc for women students.

D. General

13. In each IIT, one post (at the level of Dean) be responsible for collecting and monitoring gender based data in recruitments and JEE or similar exams. Sufficient budget to be provided for this and outreach activities targeting schoolgirls.

14. Detailed analyses of the JEE and JEE Advanced exam data looking at gender factors specifically are required. Besides analysis by JIC, anonymised raw data to be made available to other faculty who wish to study gender factors.

15. Some studies outside India have found that girls do better when there is less time pressure. It needs to be studied whether or not the format of JEE (Advanced) with multiple-choice questions and timed tests inadvertently favours male candidates.

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