

Summary Report

About Department/Center/School: Biotechnology activity at IIT Kharagpur was formally initiated in 1986 with the introduction of an M.Tech course in Biotechnology and Engineering. The program bred excellence in the sphere of teaching/training and research. The wide appreciation of the program in the country and abroad led to introduction of an undergraduate course in Biotechnology and Biochemical engineering in 1994. The Department of Biotechnology was established in 1999 to run the UG program independently.

1. Academic Programs (Range of Degrees and Disciplines):

- i) B. Tech. (Hons) : 4 years duration
- ii) Dual Degree (B.Tech (Hons) + M.Tech in Biotechnology and Biochemical Engineering: 5 years duration
- iii) M.Tech + Ph.D. in Biotechnology and Biochemical Engineering: 2 years M.Tech followed by an optional enrolment in the Ph.D. Program
- iv) Ph.D. in Biotechnology and Biochemical Engineering

2. Major 4-5 Thrust Areas of Research:

- a) Health Care Biotechnology (Infection of enteric parasite and bacteria, lead molecule identification, Structural Biology, Tissue Engg, Diagnostic Development, Immunomodulators & Neutraceuticals) ; b) Bioenergy and Environmental Biotechnology; c) Plant Biotechnology

3. Curriculum and Courses & Teaching Environment

Items	Ratio/ Number	Items	Number/%
Teacher-student Ratio	1:17.3	Average No. of students motivated (%) to opt of careers Eng/ Tech. Sectors UG/PG/PhD	20/50/50
No. of Faculty members as on today	13	Average No. of students motivated (%) to opt of careers in Science sectors UG/PG/PhD	20/50/50
Average No. of Tutorial Assistants	36	No. of teaching labs	16
No. of UG/DD students	27/26	Average No. of students per experiments in core courses	2-4
No. of PG students/PhD students	24/70	No. of Students' workshops/`Tinkering' Labs	Nil
Average no. of tutors with more than 100 students	No class > 100 students	No. of new courses introduced	3
Average Students placements (%) (UG/DD/PG)	47/61/27	No. of New program introduced	Nil
No of major curriculum review in both UG & PG level	2	Undergraduate Vs PhD strength expressed as Percentage	40
No of UG lab (teaching labs) developed/set-ups	2	No of PG/research labs developed/new set up	4
No of E class rooms	2	No. of lab classes per week	5

Average No. of Course done per student for B. Tech/DD/M. Tech/Ph.D	60/71/19/5	No. of core/elective/seminar/projects subjects taken for B. Tech, DD, and M. Tech respectively	51/9/00/2 55/11/00/4 9/6/2/2
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4. Research and Development & its Environment

Items	Number	Items	Number	Items	No.
Total No. of Publications in Journals (2008-13)	395	Average no. of citation per paper	13.72	No of large interdisciplinary research projects	10
Total No. of Publications in Conference & Symposium	166	Average Journal publication per year	55.3	Number of Int. conf./workshops attended by students	37
Total No of Books & e-books published	04	h-Index of the department since 2008/ overall h-index in Scopus	32/44	No. of PDF hired in the Institute	05
Total No of Edited Conference Proceedings/book chapters	23/10	Number of papers with citation more that the average no. of citation of the Journals	Not available	No. of international Students as PhDs/PDFs	Nil
Total No. of Technology Developed/transferred	1/1	No. of recognitions & Awards, fellows etc to faculty/students (provide break up if necessary)	4/27	No. of International visiting researchers/adjunct faculty stayed here for at least a week	11
Total No. of Patents Filed/Obtained	23/15	Average Retention(%) of Young faculty for at least 10 years	100	No. of short courses/workshops /conf. organized with international participations	08
Total No. of Copyright Filed/Obtained	01	No. of Sponsored research Project /fund(lakh) generated from non-internal source	47/1448	Average No. of PhD granted per year	8.4
No. of Publications per Faculty/Masters/PhD students	32.9/0.2/6.58	No. of Consultancy /fund (lakh) generated from non-internal source	7/26	Average No. of PhD Granted per year per faculty	0.7
No. of Publications per Faculty/Masters/PhD students in Top Ten Journals as Identified by the department	4.9/0/0.9	No of Internal and external Collaborations research papers/research projects/PhD students	130/44/29	Patent granted per faculty	1.2
Average No. of Citation per faculty per year	30.72	No of M. Tech students motivated into pursuing PhD/PhD graduates motivated to pursue career in Academics (abroad or IIT etc)	50/30	Number of articles in collaborations with Ten countries*	46
Ranking of the	1	Ranking of the	11	No of articles of	10

department in terms of average citations per paper within the Institute		department in terms of total number of Journal publications within the Institute/publications per faculty		the dept. contributing towards h-index of the Institute since 2008	
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5. External Stakeholder Engagement and others

Items	Number	Amount Lakh
No. of PhD/Master students' thesis funded by Industries	0	0
Total number of Industry sponsored projects and its income (Lakh)	0	0
No. of Curriculum Development Initiative for Industries	0	0
No of Technology transfer/adopted by Industry/Labs	0	0
No. of Nationally relevant research projects	47	1448
No of Policy inputs/consultancies provided	5	15
No. of Research grant and seed money from internal savings of the Institute per young faculty of the department and its total fund	1	5.0
No. of Community Relevant projects	0	0

6. Vision for the Future (in brief):

(a) Departments/centers/schools should spell out its Mission and Vision Statements, (b) Plans for future to achieve the projected goals and (c) measures adopted towards above.

VISION: To provide world class biotechnology education to students to make them competent to contribute the Indian bioeconomy tomorrow.

MISSION:

1. Unique curriculum development, as a bench mark, to ignite young bright minds motivating them to invent and innovate.
2. Promoting bioentrepreneurial spirit in students and faculty for meaningful application of biotechnology for societal gains.

PLAN OF ACTION

1. External Peer Review completed
2. Faculty Task Groups constituted to implement 4 major recommendations (unique curriculum development; more faculty induction for multidisciplinary engineering input to the students; exclusive laboratory development for promoting inventive spirit ; more industry interface to promote bioentrepreneurship)

MEASURES

1. Frequent meeting of Faculty and students were arrange in the last one year, taking their feedback for curricular and research related changes
2. Proposal for developing two 24X7 laboratories (one each for UG & PG) sent to the Institute and action has been initiated at the departmental level for implementing the

same. All existing laboratory facilities and experiments in lab classes have been streamlined for more intensive hands on training

3. Interactions between UG, PG and research students have been intensified significantly in the last 6 months through programs of ABT(Association of BioTechnology) making the students more involved in academics

7. External peer review of the Dept./centre/schools (in brief):

(a) Date of the peer review: 18th April 2013

(b) Name of the Experts involved and their affiliations in short:

Dr.D.M. Salunke [Chairman of the Academic peer review committee]
(Executive Director,UNESCO Regional Centre for Biotechnology(RCB), Gurgaon)
Prof. VS Bisaria(Department of Biochemical Engineering & Biotechnology, IIT Delhi)
Prof. D.K.Mitra, AIIMS, New Delhi
Dr.S.Sinha, Advisor, DBT, Govt. of India
Dr.Rajat Goyal, Country Director, IAVI, New Delhi
Dr. Pradip Bhatnagar, Daiichi Sankyo Life Science Centre

(c) Overall recommendations of the peer review committee: Strengths, weaknesses, suggestions and comments

- Curriculum should be strengthened by incorporation of more of engineering components with emphasis on microbial, plant and animal products and process developments, including scale up promoting innovative and translational research
- Improvement in analytical abilities of the students than mere problem solving
- Faculty strength should be doubled with respect to the existing strength to create critical mass for the development of domain specific teaching and research area. Adjunct and visiting faculty members should be recruited on global basis to further bridge the gap in teacher-student ratio.
- Curriculum may be restructured to provide domain specific specialization by creating provision for more options to students for choosing electives; more electives may be offered as per faculty expertise (health care, energy and environment, bioprocess development) .Experts of relevant fields(both from industry and academic/research institution) may be invited for student interaction at the department.
- A process facilitating active interactions/ collaborations through DBT with industry and other key institution in the public sector engaged in Biotech R & D should be initiated.
- Workshop by industry / other institutes / DBT experts to brainstorm on challenging problems in the area
- A process to be put mentoring students in specialized areas (health care, energy environment and bioprocess development) by the help respective faculties. This will enable the students to get more exposure to upcoming events, industrial and research advancements, job opportunities in those areas.
- More laboratory space must be created in order to give more space to each faculty members to carry out research and project works leading towards Ph.D, M Tech. / B Tech thesis. IIT being the only respected brand in Indian technical education student from this Institute must acquire unique professional competence to serve bio-industries.
- To upgrade R&D in spearheading globally impactful work in the emerging aspects of chosen thrust areas more infrastructure (animal house for clinical trial, sophisticated instruments for

biomolecular analysis, scale up equipment for bio-product development) be created with support from Institute/ funding agencies.

(d) Measures adopted/action taken at the department level to address the recommendations of the peer review report:

A) Task-Groups Constituted:

- i) Domain Specific elective in curriculum
- ii) Faculty Recruitment(with Engineering background)
- iii) Industry interface for innovation/translational research
- iv) Creating infrastructure for clinical trial etc.

B) Proposal being sent to the institute for 24X7 UG and PG laboratories promoting innovative translational research

8. Strengths, Weaknesses, Opportunities & Threats (SWOT) Analysis of the Department

<p>STRENGTHS</p> <ul style="list-style-type: none"> √ Good quality faculty √ Adequate and Quality Research outputs √ Brand image due to about 15 years of standing of the department √ Periodic updating of curriculum √ Periodic feedback of the students <p>WEAKNESSES</p> <ul style="list-style-type: none"> √ Low teacher-student ratio √ Low teacher-staff especially technical staff ratio √ Inadequate and insufficiently trained supporting staff √ Low national and international awards √ Inadequate linkages with industry and community √ Inadequate industrial growth in the country 	<p>OPPORTUNITIES</p> <ul style="list-style-type: none"> √ Boom in industrial development and challenges in Biotechnology fields put demand for quality technical manpower √ Establishment of centres of excellence and advanced studies √ To innovate new products/processes/designs and acquire patents √ Possibility of more international and national collaborations and joint ventures <p>THREATS</p> <ul style="list-style-type: none"> √ Lack of incentives at par with world class institutes such as MIT, CalTech, etc and the world class industries and infrastructure at par global level
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***Note: Ten countries: US, UK, Germany, Japan, Canada, France, Italy, Australia, Singapore, South Korea**

Important Highlights

Biotechnology: PLAN OF ACTION AND SUPPORT NEEDED FROM THE INSTITUTE

The M Tech program in Biotechnology & Engineering in IIT Kharagpur was instituted in 1986, in the first set of Institutes of Manpower Training program of DBT. The course has completed 27 years. The teaching, training and research have received recognition as a very balanced course with unique blend of basics of modern biology and bioprocess engineering. The program review by DBT after 25 years (July 2012) and recent visit of BCIL review team (March 2014) indicated that alumni have been successful in serving both academia and industries. Our alumni are maximum in number amongst those serving in industries, than from other Institutions. A common observation as a weakness of MPT run PG courses across the country, particularly in Universities is their lack of competence in adapting to industrial jobs. The BCIL team indicated therefore that IIT Kharagpur should now benchmark the M tech course as a model for other Institution, with more emphasis on igniting inventive and entrepreneurial spirits in the students. The external Peer review conducted by the Department also indicated this point as an important one.

The Undergraduate program was initiated in 1994, first in IIT system. The current limitation of the course is non-availability of befitting jobs after 4/5 years of study, an aspiration of the IIT graduates. The bio-industrial growth so far being sub-optimal, this outcome is normal. The Government of India has projected about 100 times growth in bio-economy by 2020. It is imperative therefore that we intensify training our best brains to play leadership role in this projected growth.

1. External Peer Review completed

An external peer review committee constituted of eminent Experts reviewed our academic and research programs in April 2013.

The Committee made 4 major recommendations in upgrading the academic and research program with the objective of making it more interesting to the bright students and futuristic in creating national and global impact. The Committee unanimously opined that structural change in the curriculum specific for biotechnology students (to satisfy their specialization needs suitable for industrial employment), thorough upgrading of equipment and infrastructure, enhanced faculty strength to offer more electives and R&D diversity, and more industrial interactions are essential to take the program to global standard.

2. Faculty Task Groups constituted to implement 4 major recommendations (unique curriculum development; more faculty induction for multidisciplinary engineering input to the students; exclusive laboratory development for promoting inventive spirit; more industry interface to promote bio-entrepreneurship). A group of 3-4 faculty members at all levels will take actions in implementing the recommendations.

a) Unique curriculum development- The IIT graduates aspire to be employed in industries after graduation. Moreover, such highly trained manpower should contribute to the national development with their specific training. Considering both the needs it is desirable that students acquire a set of domain knowledge befitting

with the current industrial need in India. Microbial bioprocess engineering, plant biotechnology, bioinformatics, healthcare biotechnology etc are some important areas. So, elective subjects should be so clustered that the students can opt for at least 3-4 subjects in those specific areas. Exploration of credit sharing (real time or virtual) with other reputed institutions across the world may be given importance.

- b) **Enhancing Faculty strength with multidisciplinary engineering expertise** - A premier institution like IIT Kharagpur must bench mark the academic and research program as a model for the rest of the country and it is in dire need because all other institutions are looking for a solution. Apart from recruiting new young faculty the provision for adjunct Faculty from overseas Universities should be given priority. Since high level teaching survives in high level R&D environment, an in-house collaborative R&D in niche areas of BT-IT-NT-MT should be developed, and achievement in bench scale must be advanced to the clinical trial stage in attracting industrial interest in technology transfer of inventions. With the possibility of a research centric hospital in the campus this possibility must be spearheaded. More laboratory space will be necessary in near future in undertaking such programs. The possibility of Biotechnology Department to shifting to I-Tower may serve the best purpose.
- c) **Exclusive laboratory development for promoting inventive spirit**- The Committee stressed the need for motivating UG/PG students more towards wet lab training. For inculcating inventive spirit two specific laboratories (one for UG and one for PG) with 24 hours access for their project and experimental work were advocated. Accordingly, proposals for support from Institute for establishing two such laboratories (24X7 laboratories) has just been sent to the Institute. Two new spaces for these laboratories, each with 1600 sq ft areas, have been earmarked by the Department.
- d) **Industry interface to promote bio-entrepreneurship**- In comparison to European and OECD countries bio-industrial growth in Asia as such is less achieved. But India has planned a 100 times boost in bioeconomy in 2020. More job opportunities are therefore predicted and biotechnology graduates should best utilize this through entrepreneurship. Biotechnology Department is planning to enthuse students and young faculty towards this goal. At least two workshops will be hold (partly in association with STEP) in one year inviting industrial experts and successful alums from industries.

The Department will also explore in instituting DBT-sponsored ignition/incubation programs.