

Summary Report

About the Department: Established in 1951, the Chemical Engineering Department at IIT Kharagpur continues to be in the forefront of Chemical Engineering Education and Research in the Country. At present, the department is involved in research activities in the diverse fields covering both classical and state of the art areas like Kinetics and Catalysis, Multiphase Flow, Mineral Processing, Membrane Technology, Microfluidics, Bioenergy, Petroleum Engineering, Plasma Processing; Polymer Composites; Colloids and Foams; Process Control, Modeling and Simulation, Nano Patterning, etc.

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

- (i) B.Tech. (H) in Chemical Engineering
- (ii) Dual degree [B.Tech.(H)+M.Tech.] in Chemical Engineering
- (iii) M.Tech. in Chemical Engineering
- (iv) M.S. (by research) in Chemical Engineering
- (v) Joint M.Tech.- Ph.D. in Chemical Engineering
- (vi) Ph.D. in Chemical Engg.

2. Major 4-5 Thrust Areas of Research

Separation Processes; Reaction Engineering and Catalysis; Advanced Materials; Interfacial Engineering

3. Curriculum and Courses & Teaching Environment

Items	Ratio/ Number	Items	Number/%
Teacher-student Ratio	1:20	Average No. of students motivated (%) to opt for careers in Engg/Tech. Sectors UG/PG/PhD	90/60/100
No. of Faculty members as on today	25	Average No. of students motivated (%) to opt for careers in Science sectors UG/PG/PhD	0/0/0
Average No. of Tutorial Assistants	65	No. of teaching labs	8
No. of UG/DD students	208/144	Average No. of students per experiments in core courses	4
No. of PG students/PhD students	114/70	No. of Students' workshops/`Tinkering` Labs	1
Average no. of tutors with more than 100 students	4	No. of new courses introduced	4
Average students' placements (%) (UG/DD/PG)	91/90/44	No. of New program introduced	1 (Jt.M.Tech.- Ph.D.)
No. of major curriculum review in both UG & PG level	1	Undergraduate Vs PhD strength expressed as Percentage	300% (UG/PhD)
No. of UG lab (teaching labs) developed/set-ups	1	No. of PG/research labs developed/new set up	7
No. of E class rooms	4	No. of lab classes per week	3
Average No. of Course done per student for B. Tech/DD/M. Tech/Ph.D	52/57/10/5	No. of core/elective/seminar/projects subjects taken for B. Tech, DD, and M. Tech respectively	13/06/00/02 18/06/00/04 05/05/02/02

4. Research and Development & its Environment

Items	Number	Items	Number	Items	Number
Total No. of Publications in Journals (2008-13)	402	Average no. of citation per paper	6.5	No of large interdisciplinary research projects	2
Total No. of Publications in Conference & Symposium	88	Average Journal publication per year	80	Number of Int. conf./workshops attended by students	4
Total No. of Books & E-books published	11 & 5	h-Index of the department since 2008/overall h-index in Scopus	38	No. of PDF hired in the Institute	Nil
Total No. of Edited Conference Proceedings/book chapters	~40	Number of papers with citation more that the average no. of citation of the Journals	265	No. of international Students as PhDs/PDFs	Nil
Total No. of Technology Developed/transferred	1	No. of recognitions & Awards, fellows etc. to faculty/students (provide break up if necessary)	26/02	No. of International visiting researchers/ adjunct faculty stayed here for at least a week	01/01
Total No. of Patents Filed/Obtained	4	Average Retention (%) of Young faculty for at least 10 years	80%	No. of short courses/workshops /conf. organized with international participations	Nil
Total No. of Copyright Filed/Obtained	16	No. of Sponsored research Project /fund(lakh) generated from non-internal source	35/753	Average No. of PhD granted per year	5-6
No. of Publications per Faculty/Masters/ PhD students	3.2/0.5/ 2.7	No. of Consultancy /fund (lakh) generated from non-internal source	21/437	Average No. of PhD Granted per year per faculty	0.22
No. of Publications per faculty/ Masters/ PhD students in Top Ten Journals as Identified by the department	0.91/0.15/ 0.76	No. of Internal and external Collaborations research papers/research projects/PhD students	122+25/ 4+1/5+1	Patent granted per faculty	0.16
Average No. of Citation per faculty per year	20.9	No of M. Tech students motivated into pursuing PhD/PhD graduates motivated to pursue career in Academics (abroad or IIT etc)	18/20	Number of articles in collaborations with Ten countries*	25
Ranking of the department in terms of average citations per paper within the Institute	6	Ranking of the department in terms of total number of Journal publications within the Institute/publications per faculty	10/11	No of articles of the dept. contributing towards h-index of the Institute since 2008	5

*Note: Ten countries: US, UK, Germany, Japan, Canada, France, Italy, Australia, Singapore, South Korea

5. External Stakeholder Engagement and others

Items	Number	Amount Lakh
No. of PhD/Master students' thesis funded by Industries	2/4	NA
Total number of Industry sponsored projects and its income (Lakh)	69	868.75
No. of Curriculum Development Initiative for Industries	Nil	NA
No of Technology transfer/adopted by Industry/Labs	01	16.00
No. of Nationally relevant research projects	01	52.20
No of Policy inputs/consultancies provided	-/52	-/586.73
No. of Research grant and seed money from internal savings of the Institute per young faculty of the department and its total fund	7	35.00
No. of Community Relevant projects	01	40.00

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.

In line with Vision 2020 program of the institute, the department strives to achieve excellence and aspire to be among the top 20 Chemical Engineering Departments in the world.

To achieve the projected goal, actions in specific areas like the interdisciplinary research, increase in number of researchers are already identified and are being pursued.

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

(a) Date of the peer review: February 26 & March 18, 2013

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

- (1) Prof. G. D. Yadav, Vice-Chancellor & R T Mody Distinguished Professor, Institute of Chemical Technology, Mumbai
- (2) Mr. Raj Kumar Ghosh, Director (Refineries), Indian Oil Corpn. Ltd., New Delhi
- (3) Dr. Ashish Lele, Scientist, National Chemical Laboratory, Pune

(c) Overall recommendations of the peer review committee

Strengths, weaknesses, suggestions and comments

The capability of the faculty in guiding research students from various backgrounds is well appreciated by the committee.

Fewer research students were in place compared to the expectations of the committee.

The committee suggested increasing the number research students with chemical as well as non-chemical engineering backgrounds and suggested independent guidance by the junior faculty. The committee felt that the number of research student per faculty should be around five.

The committee suggested encouraging internship in research labs/industry R&D in every summer and winter. Some specific course contents and teaching methods were also suggested.

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

The number of research students has already been increased. Thirty students have been inducted since the last review and more are expected to join. Some specific recommendations on course content and teaching methodology have already been addressed.

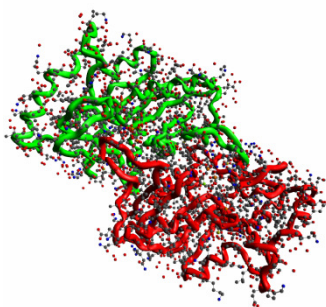
8. Strengths, Weaknesses, Opportunities & Threats (SWOT) Analysis of the Department

<p>STRENGTHS</p> <ul style="list-style-type: none">• Excellent programs with emphasis on core competency development• Traditional focus on Teaching & Laboratory experiments• Excellent undergraduate student base• Well established & Worldwide recognition of the UG program <p>WEAKNESSES</p> <ul style="list-style-type: none">• Limited Research Areas• Generally mediocre post graduate and research scholar base compared to UG student base• Inadequate infrastructural facility for research activity• Insufficient pool of bright and motivated Research Scholars	<p>OPPORTUNITIES</p> <ul style="list-style-type: none">• Excellent potential for undertaking Industry-academia collaborative research• Interdisciplinary research in the new and emerging areas• Setting up challenging research frontiers• Newer research areas being opened up by the faculty who recently joined the department <p>THREATS</p> <ul style="list-style-type: none">• Non-availability of new faculty for sustaining high end research• Inadequate infrastructural facility such as space, equipment, etc.• Faculty attrition
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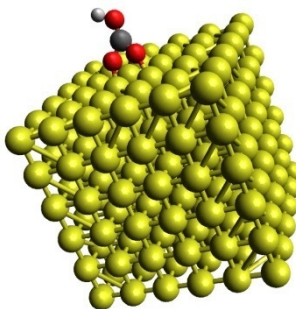
Important Highlights

(a) Initiative in new areas of research

Molecular computational research in Chemical Engineering: High speed parallel computational facilities have been developed in the department for carrying out *ab initio* electronic structure calculations and molecular simulations. Analysis of biological systems is being carried out within quantum mechanics/molecular mechanics framework in order to understand the biochemical origins of diseases like Tuberculosis with subsequent efforts to be directed towards computational drug design. Computational catalysis approach is being followed to discover novel catalysts with a detailed understanding of molecular level surface interactions targeting reactions for synthesis of pharmaceutical intermediates and carbon capture. Efforts are being made towards the development of a highly parallelized generic Monte-Carlo code for the analysis of multi-component solids with potential applications to doped-catalysts, electronic materials and multiphase solid solutions encountered frequently in metallurgical operations.



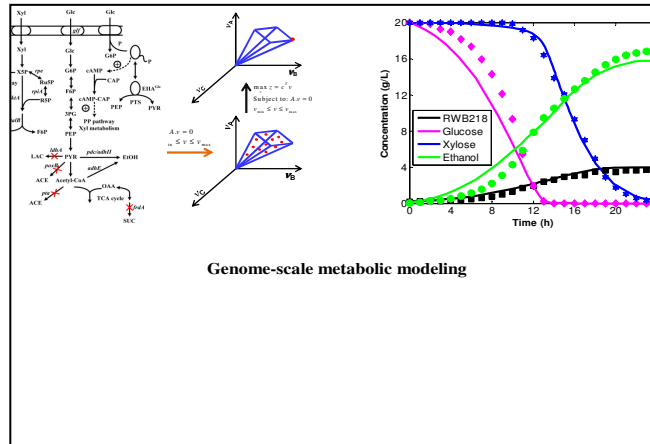
QM/MM calculation for whole-enzyme
for OPRT enzyme involved in DNA
synthesis of *Mycobacterium tuberculosis*



HCO₃⁻ ion on Cu slab for DFT calculation
for CO₂ hydration reaction giving a
bicarbonate ion

Bio-systems engineering: The availability of genome scale metabolic reconstructions of several industrially important micro-organisms and the availability of tools to analyze such models have created great opportunities to understand cellular processes at the level of the genes, proteins, and metabolites. The availability of a predictive model of whole cell metabolism gives us opportunity to manipulate cellular functions in order to design *in silico* strains for enhanced productivity.

Our current research attempts to develop and validate genome-scale dynamic models for micro-organisms of industrial interest and use these models for analysis, strain design and optimization of bioprocesses for enhanced production of fuels and high value chemicals from biomasses. We also attempt to develop novel approaches and new tools for analysis of such complex metabolic models.



Genome-scale metabolic modeling

(b) Recently added infrastructure

- Equipment: Confocal Microscope, Ion Chromatograph, AAS, High Performance Computing System, Hollow Fiber Membrane Casting Unit
- New research laboratories in areas of Quantum & Molecular Engineering, Bioenergy, Molecular Modeling & Biomechanics, Micro-structured and Porous Materials, Instability & Soft Patterning, Polymer Rheology



Imaging Ellipsometer



Confocal Microscope



Departmental Research Facility