TEQIP KNOWLEDGE INCUBATION CENTRE

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

OVERVIEW OF INTERACTIONS AND ACTIVITIES TILL NOW

(REVIEW PRESENTATION, APRIL 2014)
WHAT WE NEED TO FOCUS ON...

Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering – {STRONG TEACHING BASE REQUIRED}
(b) ability to design, conduct experiments, and analyze and interpret data
(c) an ability to function on multidisciplinary teams
(d) An ability to identify, formulate, and solve engineering problems
(e) an understanding of professional and ethical responsibility
(f) an ability to communicate effectively
(g) recognition of the need for, and ability to engage in life-long learning
(h) A knowledge of contemporary issues – HUMANITIES
(i) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
The professional component must include:

(a) **One year of a combination of college level mathematics and basic sciences**

(b) One and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs.

(c) **A general education component** that complements the technical content of the curriculum and is consistent with the program and institution objectives.

*Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.*
The faculty must be of sufficient number and must have the competencies to cover all of the curricular areas of the program.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes.

The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness
ACTIVITIES CONDUCTED SO FAR
TEQIP CONCLAVE OF EDUCATORS

On Quality of Delivered Academics in Mechanical Sciences.
UNDERGRADUATE CURRICULUM

- **BREADTH BUT LESSER DEPTH** (E.G. MULTIPLE TOPICS IN 1 COURSE – LINEAR ALGEBRA, ODE, PDE, TRANSFORM METHODS IN 1 COURSE).

- **SMALL SCIENCES DEPARTMENT WITH LIMITED SPECIALIZATION** – SERVICE DEPARTMENTS, **COMPETENCE**?

- **LIMITED ADDITIONAL ELECTIVE COURSES** – E.G. ITERATIVE SOLVERS, NUMERICAL METHODS, MATHEMATICAL MODELING, OPTIMIZATION, NONLINEAR DIFFERENTIAL EQUATIONS, WAVE THEORY, CLASSICAL MECHANICS, OPTICS, INDUSTRIAL CHEMISTRY, ETC.

- **WEAK HUMANITIES EXPOSURE** – GOOD, AWARE AND SENSIBLE CITIZENS?

- **LABORATORY EXPERIENCE** – DEMONSTRATIVE, LIMITED EXPOSURE TO NEW PARADIGMS (VIRTUAL EXPERIMENTATION, SENSORS, SYSTEM LEVEL, ETC.), LIMITED EXPOSURE TO THEORY OF EXPERIMENTATION, LIMITED HANDS-ON.

- **VECTOR APPROACH MISSING** – **WEAKNESS IN DYNAMICS, FLUID MECHANICS** – QUESTION OF RIGOR...

- **MINORS, DUAL MAJOR, DUAL DEGREE OPTIONS, FELLOWSHIPS** – OPTIONS FOR GOOD STUDENTS (HOW TO RETAIN THE GOOD ONES?)
GRADUATE CURRICULUM

➢ RIGOR OF COURSE-WORK – MATHEMATICS NEEDED, DEPTH MISSING, DEFINED SUB-DISCIPLINES (SKEWED TOWARDS POPULAR STREAMS)

➢ MORE ELECTIVES NEEDED

➢ QUALITY OF RESOURCES AVAILABLE – LIBRARY FACILITY, ON-LINE JOURNALS, REGULAR SEMINARS, EXPERT TALKS – CULTURE OF RESEARCH

➢ RESEARCH DRIVEN TEACHING – FACULTY ENGAGED IN ACTIVE RESEARCH, CONTINUOUS CONTENT DEVELOPMENT, DEMANDING PROJECTS, QUALITY OF EXPERIMENTATION.

➢ UNIVERSAL EXPOSURE – INTERNSHIPS, FELLOWSHIPS, SHORT-VISITS, ATTENDANCE IN WORKSHOPS, JOINT-SUPERVISION.

➢ RIGOROUS PROJECT/ THESIS WORK - CAN THE STUDENT COMPETE WITH THE BEST IN THE WORLD?

➢ INTERDISCIPLINARY PROGRAMS AND COURSES – QUICK TO INITIATE NEW AREAS OF STUDY.
FACULTY

- WANT ALL FACULTY WITH PhD FROM IITs, IISc, NIT – ENCOURAGE EXISTING ONES TO GET DEGREES FROM THESE.

- FACULTY-STUDENT RATIO – SUB-OPTIMAL (1:20 TO 1:100)

- SUPPORT FOR RESEARCH, PEDAGOGY – EFFICIENT MECHANISMS (TRAVEL, EQUIPMENT, INTERNET RESOURCES, ETC).

- ENCOURAGE POST-DOCTORAL EXPERIENCE, COLLABORATIVE RESEARCH IN QUALITY CIRCLE.

- ENCOURAGE EVOLUTION OF STRONG GROUPS – CENTRES OF EXCELLENCE (ACROSS INSTITUTIONS – TO CREATE CRITICAL MASS)

- SOCIETAL AND INDUSTRIAL SENSITIVITY (CENTRES FOR SOCIETAL RESEARCH, HILL TECHNOLOGY, PAINT TECHNOLOGY)

- CREATE DISTINGUISHED PROFESSORSHIPS, FELLOWSHIPS TO INVITE RENOWNED RESEARCHERS TO CAMPUS.
Vision of TKIC

PROMOTE INTERACTIONS, COLLABORATIONS, DISCUSSIONS ON PEDAGOGY AND RESEARCH

1) Mechanical sciences
2) Chemical sciences and materials
3) Electrical engineering and computer science
4) Physical sciences.

Planned activities:

• Sabbatical/long-leave stay to teachers and researchers from TEQIP institutions.
• Short-term visit of graduate students from TEQIP institutions.
ACTIVITIES SO FAR:

• **2-DAY (DECEMBER 2012) CONCLAVE OF EDUCATORS IN MECHANICAL SCIENCES**
  – BRAIN-STORMING SESSION ON PEDAGOGY

• **PRAVARTANA** (OCTOBER 2013)
  – 2-DAY WORKSHOP IN APPLIED MECHANICS

- LEADING EXPERTS FROM INDIA GAVE LECTURES ON A WIDE SPECTRUM OF TOPICS – FLUID MECHANICS, ROCK MECHANICS, HUMAN MOTION, SOLIDS…

- INITIATED DISCUSSIONS, HOPING TO CREATE RESEARCH COLLABORATIONS, CROSS-INSTITUTIONAL GROUPS.
How to throw fast, or accurately, or accurately & fast

Madhusudhan Venkadesan
National Centre for Biological Sciences, Bangalore, India.
Hazards

- Earthquake
- Wind
- Waves
- Vehicles
- Blast
- Impact
- Fire

Undesirable consequence
SYSTEMS ENGINEERING WORKSHOP
(16TH TO 20TH DECEMBER 2013)

• ON-DEMAND FROM THE QC INSTITUTIONS

• EMPHASIS ON DEVELOPMENT AND ESTABLISHMENT OF SYSTEM IN NASCENT STAGE – IMPORTANT COURSE

• MANAGEMENT, INDUSTRIAL ENGINEERING, MANUFACTURING AND DESIGN ASPECTS STRESSED

• A NEW PERSPECTIVE FOR PRODUCT/SYSTEM DEVELOPMENT

• INTERACTION WITH PROJECT MANAGERS FROM ISRO – PRACTICAL EXPERIENCE
International Workshop on
Novel Combustion Concepts for Sustainable Energy Development

Organized by
International Society for Energy, Environment and Sustainability
In collaboration with
TIKC, TEQIP, IIT Kanpur
List of Speakers

1. Prof. S. R. Chakrabarthy, IIT Madras, India
2. Prof. Swarnendu Sen, Jadavpur University, India
3. Prof. Achintya Mukhopadhyay, Jadavpur University, India
4. Prof. K. Kitagawa, Nagoya University, Japan
5. Prof. S. Kerdsuwan, KMUST, Bangkok, Thailand
6. Prof. Franz Winter, Technical University of Vienna, Austria
7. Dr. Ashok Pandey, NIIST, Trivandrum, India
8. Dr. R. K. Malhotra, IOCL R&D, Faridabad, India
9. Prof. Ajay K. Aggrawal, University of Alabama, USA
10. Dr. K. Umamaheswaran, GE Aviation, India
11. Prof. Kalyan Annamalai, Texas A&M University, USA
12. Prof. Subramanyam R. Gollahalli, University of Oklahoma, USA
13. Dr. Ryo Amano, University of Wisconsin, USA
14. Prof C. Thomas Avedisian, Cornell University, USA
15. Prof. Suresh K. Aggarwal, University of Illinois, Chicago, USA
16. Prof. Ashwani K. Gupta, University of Maryland, USA
17. Prof. Ramesh K. Agarwal, Washington University, USA
18. Prof. Hukam C. Mongia, Purdue University, USA
19. Dr. Gabriel D. Roy, Office of Naval Research Global, USA
20. Prof. Abhijit Kushari, IIT Kanpur, India
21. Prof. Avinash Kumar Agarwal, IIT Kanpur, India
22. Dr. Tarun Gupta, CE, IIT Kanpur, India
23. Dr. B. R. Gurjar, CE, IIT Roorkee, India
24. Prof. R. P. Sharma, Jaipur, India
25. Prof. Raj Bordia, Clemson University, USA
This workshop focused on required course content and pedagogy of Combustion and Engine Research and education both in undergraduate and post graduate levels as well as the research ideas and methods in related issues.
PEDAGOGY TALKS

• **Computational Combustion and CFD**: Dr. A. K. Runchal, ACRI CFD

• **Combustion**: Prof. S. K. Aggrawal, University of Illinois at Chicago

• **Experimental methods in combustion research**: Prof. A. K. Gupta, University of Maryland, College Park

• **Gas Turbine Engines**: Dr. A. Kushari, IIT Kanpur.

• **Establishing an IC engine lab**: Prof. A. K. Agarwal, IIT Kanpur

• **Laser based measurements for combustion and fluid mechanics (LDV, PDPA, PIV, PLIF)**: Dr. Deepak Sharma (TSI) and Mr. Satyanarayana (Tesscorn)
OUTCOMES:

• INITIATION OF COLLABORATIVE DEVELOPMENT OF INDIGENOUS MULTI-PHYSICS SOLVERS

• INTEREST IN 7-14 DAYS LONG COURSES IN FLUID MECHANICS, COMPUTATIONS, EXPERIMENTATION WITH PARTICIPATION FROM FACULTY FROM MARYLAND AND URBANA-CHAMPAIGN

• CREATION OF A FLUIDICS FORUM WITH PARTICIPATION FROM THE QC INSTITUTIONS

• EXCITEMENT ABOUT THE TKIC PARADIGM AND THE INDIA STORY
TEQIP WORKSHOP ON TEACHING METHODOLOGIES AND CHEMICAL AND MATERIAL SCIENCE

• FOCUSSING ON PEDAGOGY AT UG LEVEL

• DEALT WITH MATERIAL SCIENCE, MATERIAL ENGINEERING
• CHEMICAL ENGINEERING – STRESS ON RATE PROCESSES, FLUID MECHANICS, THERMODYNAMICS, PROCESS CONTROL, DESIGN
• RIGOUR REQUIRED
• SIMILAR PROBLEMS FACED BY FACULTY – LABORATORY RESOURCES, BASIC SCIENCE COURSES, STANDARD CURRICULUM
• DESIRE MORE TEACHING WORKSHOPS, RESOURCE CREATION
• HIGH STUDENT TO TEACHER RATIO

• MATERIAL SCIENCE NOT PART OF CURRICULUM – NEED TO INTRODUCE IT (DEFINITELY THROUGH A GRADUATE PROGRAM)
• NEED TO EMPHASIZE STRUCTURE AND PROPERTY OF MATERIALS
• RIGOROUS EXPOSURE TO MATERIAL TESTING REQUIRED
• ELECTIVES ON NEW MATERIALS – ELECTRONIC, ORGANIC, BIOLOGICAL.
• NANO-MATERIALS, BIO SENSORS, DISPLAY TECHNOLOGY NEED TO BE BROUGHT IN THE CURRICULUM – ELECTIVES, DEPARTMENTAL

• INTER-DISCIPLINARY NATURE OF SUBJECT – MATERIAL SCIENCE, BIOLOGY, CHEMISTRY, MECHANICAL.

• NEED A MODEL CURRICULUM IN MATERIAL SCIENCE AND ENGINEERING.

• STUDENTS EXPRESSED NEED FOR EXTENSIVE COURSES AND BETTER EXPOSURE TO FUNDAMENTALS – FLUID MECHANICS, STRUCTURE AND PROPERTIES OF MATERIALS.
## TKIC (TEQIP Knowledge Incubation Centre)

### Summary of Attendance in workshops/conferences

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<tr>
<th>S.No</th>
<th>INSTITUTES</th>
<th>PRAVARTANA</th>
<th>SYSTEMS ENGINEERING</th>
<th>NOVEL COMBUSTION</th>
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**ANNOUNCEMENTS DO NOT REACH THE FACULTY INTERESTED FACULTY BUT LIMITED SUPPORT FROM INSTITUTIONS**

**RELEVANT AREAS BUT DISMAL PARTICIPATION**

**NO MONETARY COMPULSIONS – REDUCED SERIOUSNESS**

**DOMAIN SPECIFIC PERSONS NOT SENT – DESIGNATED PARTICIPANTS IRRESPECTIVE OF DOMAIN**
AN INTERESTING EXPERIENCE:

ACADEMIC ADMINISTRATORS FROM STATE COLLEGES OF GUJARAT (17-19 FEB)

3-DAY VISIT TO IIT KANPUR TO LEARN ABOUT HOW IIT KANPUR FUNCTIONS

SESSIONS UNDER 5 BROAD HEADS –

i. GENERAL ADMINISTRATION,
ii. ACADEMIC ADMINISTRATION,
iii. STUDENT ADMINISTRATION,
iv. RESEARCH AND DEVELOPMENT ACTIVITIES,
v. OUTREACH ACTIVITIES (QIP, INTERNATIONAL, ALUMNI AFFAIRS)

TALKS BY DIRECTOR, DEPUTY DIRECTOR, REGISTRAR, FINANCE OFFICER, ADMINISTRATIVE OFFICER, SUPERINTENDING ENGINEER, SECURITY IN-CHARGE

TALKS/DISCUSSIONS BY ACADEMIC SENATE CONVENER AND PARLIAMENTARIAN

TALKS/DISCUSSIONS BY SENATE NOMINEES TO BOARD OF GOVERNORS

TALKS/DISCUSSIONS BY DEANS – ACADEMIC, RESOURCE AND PLANNING, STUDENT AFFAIRS, R&D, FACULTY AFFAIRS
DISCUSSION ON STUDENT SENATE – IT’S POWERS AND RESPONSIBILITIES

DISCUSSIONS WITH HEADS OF DEPARTMENTS, UG AND PG AFFAIRS COMMITTEES CHAIRS AT THE DEPARTMENT AND INSTITUTE LEVELS

OUTCOME OF THE MEETING:

HOW AUTONOMY IS HANDLED - FLAT STRUCTURE, COMMITTEE DRIVEN, TRANSPARENT AND DISCUSSION BASED

HOW ENABLERS FOR FACULTY CAN BE CREATED –

CREATE INTERNAL ACCOUNTS (FOR PROFESSIONAL DEVELOPMENT) FOR INDIVIDUAL FACULTY, AND FOR DEPARTMENTS. PART OF R&D FUND BROUGHT IN IS SENT TO EACH OF THESE ACCOUNTS – CAN BE USED FOR TRAVEL, EQUIPMENT, HOSTING INVITEES, SENDING STUDENTS TO CONFERENCES, ETC (ALLOWS TREMENDOUS FREEDOM TO FACULTY TO FUNCTION)

DIRECTOR DELEGATES SANCTIONING AUTHORITY TO DEANS, AND ONLY STEPS IN FOR LARGE FUND REQUIREMENTS
SUMMER INITIATIVES – WE HAVE TO USE THE SUMMER PERIOD

• SUMMER INTERNSHIP FOR 10 STUDENTS FROM QC INSTITUTIONS (10 WEEKS – MAY TO JULY)

• SUMMER VISITING FELLOWSHIPS TO UPTO 10 FACULTY – FOR RESEARCH COLLABORATION AT IIT KANPUR

• SUMMER EFFORT FOR CURRICULUM DEVELOPMENT

• CONTENT DEVELOPMENT EXERCISE IN SUMMER

• NKN/BRIHASPATI PLATFORM BASED EXPERT LECTURES TRANSMISSION

THINK OF HAVING SIMILAR ACADEMIC CALENDARS FOR ALL INSTITUTIONS – SO THAT 8-10 WEEKS IN SUMMER OVERLAP (CURRENTLY ONLY 1 MONTH OVERLAP FROM END OF MAY TO END OF JUNE)
PRAVARTANA –

INTERNATIONAL CONFERENCE AND WORKSHOP ON MECHANICS
(19-25 JULY 2014)

ANNOUNCEMENTS MADE 2 MONTHS AGO – REGISTRATION ONLY 7 TILL NOW

THE BEST DOMAIN EXPERTS TO PARTICIPATE IN CONFERENCE AND PEDAGOGY WORKSHOP – NEED TO GENERATE A FEVERISH EXCITEMENT SO THAT WE CAN CREATE A PERMANENT LIASION WITH THESE EXPERTS/INSTITUTIONS

WANT GRADUATE STUDENTS TO PARTICIPATE

NEED PUSH FROM INSTITUTIONS, NPIU, MHRD.
• DEVELOPMENT OF AN E-LEARNING PLATFORM –

• PLATFORM DEVELOPED BY CSE DEPARTMENT (PROF. TV PRABHAKAR) AND READY FOR USE

• MOOCS COURSES IN JUNE/JULY/AUGUST – THEORY OF COMPUTATIONS; COMPUTER ARCHITECTURE AND SOME MORE

• REVIEW MEETING – THEORETICAL COMPUTER SCIENCE

• VISITING RESEARCHER PROGRAM (FOR FACULTY FROM QC INSTITUTIONS)

• 10 POSITIONS ANNOUNCED – APPLICATIONS FROM ABOUT 10-15 FACULTY FROM QC INSTITUTIONS

• COLLABORATIONS WITH FACULTY FROM CHEMICAL ENGG., MECHANICAL, AEROSPACE, MATERIALS.

• HOPE TO CREATE MORE SYNERGY AMONGST THE QC INSTITUTIONS
SUMMER COURSES FOR TEACHERS:

• **DYNAMICS AND VIBRATION COURSE** – PLANNED IN END OF MAY OR 1\textsuperscript{ST} WEEK OF JUNE

• **CORE PHYSICS** – END OF JUNE OR JULY

• **TELECOMMUNICATION** – END OF JUNE

• **THEORETICAL COMPUTER SCIENCE** – END OF JUNE/ MID JULY

• **COMPUTATIONAL FLUID MECHANICS + MULTI-SOLVER INITIATIVE FOR QC– WITH DR. A. RANCHAL (CREATOR/OWNER OF ANSWER SOFTWARE) IN SUMMER**

• GOAL IS TO ALSO FIX A MODEL CURRICULUM FOR THESE COURSES AS AN ADDITIONAL OUTCOME OF THE COURSES.

• ADDITIONAL CURRICULUM DEVELOPMENT WORKSHOPS TO BE ARRANGED WITH SMALL GROUPS OF FACULTY FROM QC (SOME BASIC COURSES AND NOT THE FULL SET)
• SUMMER INTERSHIP FOR STUDENTS (UG/PG)

• 6-8 WEEKS INTERSHIP AT IITK FROM QC INSTITUTIONS

• 10 POSITIONS ANNOUNCED (MORE MAY BE GIVEN)

• ABOUT 80 APPLICATIONS RECEIVED

• ISSUE: ACADEMIC WINDOW AVAILABLE ONLY FROM END OF MAY TO END OF JUNE (THIS IS NOT IN SYNC WITH INTERNATIONAL PRACTICES OF ATLEAST A 10 WEEK BREAK)

• CONCERNS:

  - HOW DO YOU ATTRACT THE BEST FACULTY TO THE TEQIP INSTITUTIONS (USP?)
  - FINANCES, AUTONOMY TO FACULTY, MOBILITY, QUALITY
  - PART-TIME FACULTY, SKEWED STUDENT-TEACHER RATIO, RECRUITMENT?
  - ABILITY TO INTERNALIZE THE KNOWLEDGE
  - LACK OF FOLLOW UP INTERACTION WITH EXPRESSION OF INTEREST FROM QC INSTITUTIONS AND FACULTY
CLOSURE

NEED BETTER COORDINATION WITH TEQIP COORDINATORS - NEED TO RESPOND

NEED EFFICIENT TRANSFER OF INFORMATION TO THE FACULTY

NEED EFFECTIVE FEEDBACK { letter of intent seems to have helped to some extent}

WHY CONFIRMATION REQUIRED FOR GRANTING OF LEAVE - DELAY IN PROCEDURES

NEED TO CREATE (INDEPENDENT) LOCAL CENTRES OF EXCELLENCE IN NICHE/RELEVANT TECHNOLOGIES

LONG WAY TO GO - NEED COOPERATIVE APPROACH AND DESIRE TO EXCEL

NEED SUPPORT OF STATE - IDENTIFY FEW INSTITUTIONS TO GO TO NEXT LEVEL

NEED EXTENSION OF PROJECT TILL MARCH 2015, TO BE ABLE TO SPEND THE MONEY