

# IV EDUCATIONAL PROCESSES

*The design of an effective academic system is crucial to support the strategic activity mix of the Institute.*

## 4.0 INTRODUCTION

Academic programmes are at the core of the Institute's functions. They comprise the three basic activities – education, research and services – articulated in the Institute's Mission Statement. The Institute's academic activities are currently divided between Departments and Centres. The emphasis in the Departments is on education and research, while that in the Centres is on interdisciplinary research and services. The Departments are responsible for awarding all the Institute degrees, while the Centres are primarily engaged in research and services.

The main Goals of the academic programmes of the Institute can be stated as follows:

- ❑ To impart high quality undergraduate (UG) education that includes mastery of the fundamentals of Science, Engineering, Technology and Management to prepare students for a variety of challenging careers.
- ❑ To impart high quality postgraduate (PG) education that is interdisciplinary, research-based, and focused on applying advanced concepts and skills.
- ❑ To pursue research characterized by interdisciplinary inquiry for generating knowledge, technology development and applications in chosen areas.
- ❑ To impart state-of-the-art knowledge and skills to diverse stakeholders, through continuing education, enabling them to make improved professional contributions.

The design of an effective academic system is crucial to support the strategic activity mix of the Institute. This chapter outlines the changes in academic organization and programmes which have been proposed in response to environmental challenges. Some of these changes have already been implemented e.g., the new B.Tech curriculum, introduction of new courses such as Engineering Design, and Computer Aided Drafting, introduction of new programmes such as the dual-degree M.Tech programme, User-Oriented M.Tech programmes in Automotive Engine Technology, Computational Engineering, Construction Technology, Digital Signal Processing, Information Technology, Ocean Engineering and Software Engineering,



Students in the Library

UG and dual degree programmes in Biotechnology and Engineering Physics.

The anticipated paradigm shifts in learning are indicated in Table 4.1 [adapted from reference 17]. The strategic changes recommended in the next section will be consistent with these directions of change.

## **4.1 STRATEGIC INITIATIVES AND ACTION PLANS**

The existing structure of academic programmes at the Institute has been critically analysed in the context of the Institute's emerging environment, the best practices in academic curricula around the world, and IITM's Mission. The recommendations made in this chapter recognize that resources (human, financial and physical) are limited, and hence initiating new academic activities will entail restructuring or even elimination of some existing activities.

### **4.1.1 Research**

- Through extensive discussions in the Institute and from the reports of the Task Forces and Working Groups, the following sixteen inter-disciplinary areas of research have been identified as the main research priorities of the Institute. These areas will encompass the research activities of the Centres and Departments and become the basis for all research based PG education and research at the Institute. Annexure IV lists the sub-areas corresponding to these areas.

1. Biotechnology
2. Chemical Physics and Molecular Biology
3. Communication Technology
4. Complex Systems
5. Computational Engineering
6. Development Studies
7. Energy Technology
8. Environmental Technology
9. Infrastructure Technology
10. Instrumentation and Control
11. Materials Technology
12. Measurement, Testing and Diagnostics
13. MEMS
14. Methodologies
15. Quality assured Design and Manufacturing
16. Transportation Engineering

These interdisciplinary programmes should be the thrust areas of research at the Institute, and should be independently reviewed at least once in five years, and changed, if needed.

- Research programmes should primarily be user-driven and performance-oriented, and aimed at obtaining results in the medium-term. At least eighty percent of IITM's research should be in the above sixteen programmes. All research, except individual research, should be programme-based and in the form of different projects.

- ❑ Research Coordinators need to be appointed for each of the above programmes for a three-year term. The Institute should provide seed money to the Research Coordinators for evolving a strategy for technology development. The Research Coordinators should submit proposal(s) within a period of six months from the time of their appointment.
- ❑ An increased level of autonomy and corresponding accountability are necessary for academic areas which need to grow and evolve faster than the rest of the Institute, in response to shifting environmental needs. The creation of new academic units, to be called “Schools”, can fulfil this need. Keeping in mind the need for autonomy, the Senate needs to play a supportive, supervisory role in developing guidelines for such Schools. It is proposed that IITM consider establishing such Schools in the areas such as Management, Energy, Environment, Manufacturing, over the next five years.

Workshop Facilities



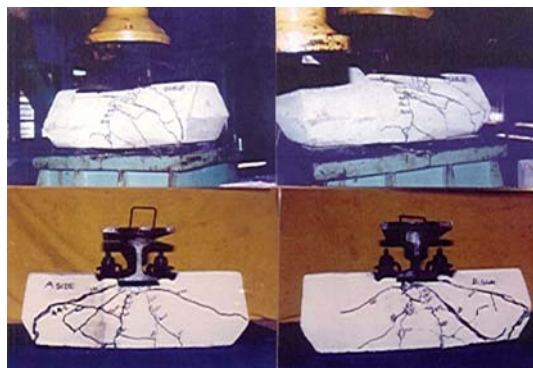
#### 4.1.2 Course-based Programmes

- ❑ The UG programmes of the Institute should continue to focus on traditional disciplines offered by the departments. Interdisciplinary UG programmes should be offered on an Institute- wide basis. The UG programmes need to provide the fundamental capability and broad base for employment, entrepreneurship or for advanced studies in more specialised areas.
- ❑ Curricular changes, in response to changing requirements are being made periodically. Need-based changes in content, design, delivery, and evaluation are carried out every semester. Recent, major restructuring of the UG programmes of the Institute (vide Annexure III) is a significant initiative in the proposed direction. To facilitate optimal use of faculty time, cross-departmental listing of courses that are of common interest should be implemented. Examples of such courses are: Numerical Methods, Finite Element Methods, and Operations Research.
- ❑ The PG programmes of the Institute (M.Sc, M.Tech, M.B.A., M.S. and Ph.D.) will be in specialised areas of knowledge, reflecting the research strengths and priorities of the Institute, emerging frontier areas of Science and Technology, and manpower needs in the fast-changing professional S&T market. Specialized elective courses for the UG programme may be related to the Research programmes identified in 4.1.1.
- ❑ M.Tech / M.Sc programmes should be inter-disciplinary in nature, wherever applicable. These programmes are conceived as being specialised, user-driven and application-focused,

deriving their knowledge-base and methods from a variety of Engineering and Science disciplines. This strategy will enrich the distinctive character of IITM as a “Research University”. The existing departmental Master’s programmes can continue to be offered with Institute-wide inputs, in line with PG priorities. Students with different UG backgrounds could be selected for the inter-disciplinary Master’s programmes according to their aptitude and academic standing.

- ❑ The Science departments in IITM have a distinct identity, clearly distinguished from similar units in Universities. Besides UG and PG electives, these departments should consider offering masters programmes with an applied focus, in collaboration with the Engineering departments. One such recent example is the M.Tech programme on Industrial Mathematics and Scientific Computing. Other suggestions include Fuzzy Logic and Control, Surface Phenomena, Catalysis, Applied Optics, and Optimization. Such programmes will have strong, organic links with the Institute’s research strategy. This implies significant restructuring of existing M.Sc. and M.Tech. programmes.
- ❑ A separate department of Biotechnology has to be established. Life science subjects should be introduced both as core and elective subjects in the UG programmes of all departments.
- ❑ A separate department of Management should be
- ❑ established to offer UG courses and PG programmes. This school should be carved out of the present Department of Humanities and Social Sciences. Visiting faculty from Industry should be invited to participate in the teaching and research programmes of the School.
- ❑ All engineers must learn a number of concepts such as: systems thinking, evolution of the natural world, the interdependence of humans and the environment, mirroring natural system in resource use and cycling, remediation of environmental problems, and preservation of biological diversity.

Reinforced Concrete  
Testing



- ❑ The process of education must emphasize active, experiential learning and real-world problem solving using the campus as a laboratory for environmental management and sustainability.
- ❑ Students should be permitted to register for a certain number of courses in other academic institutions under academic advice. Similarly, students from other institutions national / international may be permitted to register for courses offered in IITM under certain conditions.
- ❑ The progress of students should be regularly monitored and their choice of courses approved by

- ❑ Individually assigned academic counsellors. Academic counselling is to be performed as a continuing activity throughout each student's stay in the Institute. It must be distinct from personal counselling made available through an Office of Student Services.
- ❑ In order to provide a “reality check” on Education and Research in IITs, it is important to develop a meaningful interaction with Industry and the Government. It is desirable to set up an Advisory Committee in each Department consisting of a few prominent industrialists, a senior representative of the planning arm of the Government as well as a few academicians of repute from outside the Institute, in order to advise the Heads of Departments as well as the Research Coordinators in matters relating to curricula and research. The Committee should meet at least once a year and the feed back from the Committee should be placed before the Senate in a structured format. Such meetings will also provide the Departments / Research Groups an opportunity to create an awareness about the relevance of research activities.



Water Jet Cutting  
Machine

#### 4.1.3 Technology Enhanced Learning

- ❑ The World Wide Web has revolutionized earlier concepts of using computers and networks to create, store and disseminate information as well as to manage intellectual property rights, and to create viable Digital Library services. There is an urgent need to exploit these rapid advances in Information and Communication Technologies and provide :
  - Large-scale access to and enhancement in the quality of technical education in the nation.
  - Periodic training to engineering teachers and working professionals at their work-place to maintain and upgrade their IT and related skills.
  - Access to information through creation of a digital library.
- ❑ IITM should pioneer the exploitation of developments in information technology to accumulate, store and disseminate knowledge and education in three sectors: university, industry and government. There should be a Committee to direct and implement Technology Enhanced Learning activities. To begin with, this may involve three initiatives:
  - Setting up a Digital Library.
  - Development of Courseware.
  - Delivering Distance Education.

- ❑ The overall objective should be the development of new learning environments that will provide greater access and enhancement to acquisition of critical knowledge, skills, and abilities for economic and social development.
- ❑ All faculty will be placed in a matrix structure that will require them to be appointed in a Department, and simultaneously be associated with one or more Research Programmes listed earlier. The matrix structure will create academic synergy in the Institute.
- ❑ The proposed Action Plans are consistent with the Institute's emerging environment and its proposed governance. They also reflect the Institute's priority to strengthen the PG programmes and attract high-quality faculty and students, necessary to maintain the character and excellence of IITM as a leading Research University.

Central Library Counter



#### **4.1.4 Continuing Education**

- ❑ *Continuing Education Programmes at IITM need to:*
  - Lay greater emphasis on meeting industry / user needs and explore the possibility of collaboration with other leading institutions for this purpose.
  - include open-learning programmes, using advanced educational technology.
  - Include technology up-gradation and manpower development programmes for the middle and higher level professionals of Industry.

#### 4.1.5 Strategic Alliances

- q The Institute should explore and enter into strategic alliances for its academic programmes (UG, PG, Research and Continuing Education) with leading international institutions in order to exploit global opportunities. The alliances should fulfil the general conditions outlined in chapter VII on Governance. Some examples of possible alliances are:

- Joint degree programmes.
- Student and faculty exchange programmes.
- Joint research programmes.
- Overseas campus programmes.

Value addition, mutuality and synergy should be the guiding principles in forming and operating the alliances. Research programme Coordinators must propose specific alliances for their programmes.

- ❑ Recent successful models of strategic alliances at IITM are:

- Aerospace Technology Development, with Indian Space Research Organisation.
- User-oriented Masters programmes in :
  - Construction Technology and Management, with Larsen & Tubro – ECC.
  - Automotive Technology with Indian Society.
  - Digital Signal Processing with Texas Instruments, Analog Devices and Philips.
  - Software Engineering and IT with Laser Soft Info Systems Ltd., Inautix Technologies (I) Pvt. Ltd., Hexaware Technologies and Scap Velocity Net Solution Ltd.
  - Computational Engineering with Tata Consultancy Services.
    - Ocean Technology Development with National Institute of Ocean Technology.
    - Research Collaboration, with Indian Space Research Organisation and the Indira Gandhi Centre for Atomic Research.
    - Certificate Course in Computation Engineering with BHEL.
    - PG programme in Industrial Mathematics and Computer applications with University of Kaiserslautern.





X-ray Generator with  
Vertical Diffraction Facility