

## 1. THE INSTITUTE

In order to cater to the country's need of trained manpower of higher learning in science and technology, the Indian Institute of Technology at Kharagpur, first of the chain of seven IITs, was established in 1951. The idyllic, sylvan setting at Hijli was chosen to provide a cordon sanitaire to the serious learners for uninterrupted pursuit of studies. From a modest start in the dilapidated Hijli jail buildings, IIT Kharagpur has gone on to be engaged in a virtually continuous process of development. The handsome main building with its majestic tower was inaugurated in 1956 and Pandit Jawaharlal Nehru in the first convocation in the same year said "Here in the place of that Hijli detention camp stands this fine monument of India, representing India's urges, India's future in the making. This picture seems to me symbolic of changes that are coming to India".

Today, IIT Kharagpur has come a long way to its present position of pre-eminence with nineteen academic departments, seven multidisciplinary centers, a School of Management, a School of Telecommunications, a School of Medical Science and Technology, and a School of Information Technology, and several sophisticated central facilities. It is the largest and the most diversified among the IITs and strives to produce scientists and technologists of the highest caliber to help the nation become self-reliant in its technological needs and to provide leadership in the field of technical education and research. Some of the distinctive features of the programmes at IIT Kharagpur are science based engineering education, emphasis on complete education, continuous internal evaluation and flexibility for experimentation, upgradation and innovation in curriculum design. IIT Kharagpur has a number of distinctions to its credit among all the IITs, such as the First Master's programme on Management, First Master's Programme on Medical Science and Technology for practising Medical Doctors, First Postgraduate Diploma in Information Technology. In a study, sponsored by the Department of Science and Technology, Government of India, IIT Kharagpur has the highest relative employment productivity index among the IITs and is the top supplier of fresh engineers/technologists to the public and private sector industries. It also ranked first among the IITs in the production of science and engineering PhDs.

## 2. ACADEMIC STRUCTURE OF THE INSTITUTE

Number of Departments :	19
Number of Centres :	7
Number of Advanced Schools :	4
Number of B.Tech./B.Arch. Courses :	17
Number of Dual Degree Courses :	15
Number of M.Tech. Courses :	47
Number of B.Sc./M.Sc. Courses :	7

### 3. POSTGRADUATE DEGREES/DIPLOMAS CONFERRED IN THE YEAR 2005

Ph.D. :	50
M.Tech./MCP/MBM /MS/MMST :	517
PGDIT /PGDMOM :	66
M.Sc. :	97

### 4. SCHOOL OF MEDICAL SCIENCE & TECHNOLOGY

#### Human Development and Biomedicine

The society is in the midst of a major revolution in biomedicine with stunning discoveries being made in biological and medical sciences.

If our medical community is to play a meaningful role nationally and internationally we must be second to none in the application of advanced technologies to the real problems of man and society. It is well realized that, for the benefits of modern medicine and healthcare to reach the deprived community who have been denied the critical healthcare services due to various socio-economic and geographical reasons, connectivity through telemedicine is a crucial and cost effective method.

#### Synergy between Medicine and Technology

The core health care management and research in medical sciences will witness the merging of frontier technologies and medicine. To meet these challenges, a new breed of medical professionals is required, who will be conversant with both medical profession and its technological development, and will be able to fuse together the medical sciences with the emerging technologies.

The research done through this kind of collaboration between doctors and technologists will ultimately meet the requirements of the medical profession, and facilitate the progress in the field of medicine with a long-term perspective.

#### The Role of IIT Kharagpur

In the year of its Golden Jubilee in 2001, IIT Kharagpur introduced an interdisciplinary three years *Masters Programme in Medical Science and Technology*, first of its kind in the country. Masters in Medical Science and Technology (MMST) program is offered under the School of Medical Science and Technology of the Institute. The school was started with the objective to provide a platform of interdisciplinary teaching and research in biology and medicine. Admission to the MMST program is granted to 10 medical students each year on the basis of the performance in an entrance Test conducted all over the country. The School has collaboration with top hospitals and research centers all over India. *The MMST program offered by the School is the only comprehensive physician-scientist training program in India which aims to bridge the gap that has historically separated biological sciences from engineering and physical sciences.*

The renowned faculty and the well-equipped state-of-the-art laboratories of the Institute have contributed considerably in building up this program and continues to play a significant role in the teaching and ongoing research activities of this School. Some of the areas identified for teaching and R&D activities of the School are:

- Biophysics
- Bioinformatics/Telemedicine/Information Technology
- Implant Materials and Prosthesis/ Biomaterials/Biomechanics
- Immunotechnology/Recombinant DNA Technology
- Biomedical Simulation
- Medical Imaging/Biomedical Instrumentation
- Nuclear Medicine, Radiation Therapy and its Effects

### **Job Opportunities**

Till date two batches of students (admitted in the year 2001 and 2002) have graduated from the school with the degree of Masters in Medical Science and Technology. On successful completion of the programme, while some of them are pursuing Ph.D in diverse fields such as nano-biotechnology, molecular imaging, stem cell culture and tissue engineering, neurosciences and tele-surgery; others are working on various health related projects in India and abroad. They have been sought after globally as they are well-trained to act as an excellent interface between medicine and technology.

### **Curriculum**

The three MMST programme consists of 4 semesters of course work spread over the first two years. The third year is totally devoted to project work, involving dissertation. The students undergo summer and winter training in various reputed national and international research institutes, laboratories and industries engaged in research and manufacture of medicine, pharmacology and medical instrumentation. Some of the Institutes which have provided hands-on training to the students are: All India Institute of Medical Sciences, New Delhi, National Brain Research Centre, Gurgaon, Sree Chitra Tirunal Institute of Medical Sciences and Technology, Thiruvanthapuram, Narayana Hrudyalaya, Bangalore, Ranbaxy Laboratories, New Delhi, GE Corporate Research Centre, Bangalore, National Institute of Virology, Pune, RIKEN Brain Research Institute, Japan, National University of Singapore, University of Zurich, Switzerland, CRIM Lab., Scuola Superiore Sant' Anna, Pisa, Italy, University of Fukui, Japan, University of Hamburg, Germany, University of Leeds, England, etc.

### **Assistantship:**

An assistantship of Rs.10.000/ per month is given to all the eligible students. However, to be eligible for the assistantship, the student are required to maintaining good academic performance, and also serve in B.C. Roy Technology Hospital of the Institute for 6-8 hours per week. The Hospital has 35 beds with well-equipped pathology laboratory, X-ray department, ICCU and covers areas of pediatrics, dental, dermatology, ophthalmology, ENT and orthopaedics. It has round the clock emergency service, and morning and evening OPD service.

The course curriculum (which is currently under revision) comprises the following topics:

#### ***First year: Autumn Semester***

1. Introduction to Materials and Processes in Manufacturing
2. Engineering Drawing & Graphics
3. Physics for Medicine and Biology
4. Programming & Data Structures
5. Biomedical Mathematics

**First Year: Spring Semester**

1. Biomaterials - I
2. Basic Electronics
3. Instrumentation & Control
4. Engineering Mechanics
5. Information Technology

**Second Year: Autumn Semester**

1. Medical Imaging
2. Immunotechnology
3. Biomaterials - II
4. Elective - I
5. Elective - II

**Electives - I and II (any two)**

1. Telemedicine
2. Nuclear Medicine, Radiation Therapy and its Effects
3. Biophysics
4. Biomechanics

**Second Year: Spring Semester**

1. Medical Technology, Society and Ethics
2. Recombinant DNA Technology
3. Biomedical Instrumentation
4. Elective - III
5. Elective - IV
6. Project

**Electives - III & IV (any two)**

1. Biomaterials - III
2. Nutritional Sciences and Plant-based products
3. Bioinformatics
4. Simulation of Biomedical systems

**Third Year**

This consists of : Mini-project, Final year project, Dissertation and Seminar, and Comprehensive Viva Voce

(Please refer to the website for the detailed syllabus) <http://gate.iitkgp.ac.in/mmst/>

**Faculty associated with MMST teaching**

Prof. N. Dhang, Civil Engg.
Prof. S C De Sarkar, Comp. Sc. Engg
Prof. Sujoy Ghosh, Comp. Sc. Engg.
Prof. J. Mukhopadhyay, Comp. Sc. Engg
Prof. D. K. Nanda, Comp. Info. Centre

Prof. J. C. Misra, Mathematics
Prof. S. B. Singh, Met. & Mat. Engg,
Prof. A. B. Chattopadhyay, Mech. Engg
Prof. S. K. Roychowdhury, Mech. Engg.
Prof. B. Maiti, Mech. Engg.
Prof. S. K. Ghatak, Phys. & Meteorology
Prof. A. K. Roy, E & ECE
Prof. P.K. Biswas, E & ECE
Prof. A.K. Majumdar, Comp. Sc. Engg. & SMST
Prof. K. Chaudhury, SMST
Prof. S. K. Guha, SMST
Prof. A. K. Ghosh, Biotech.
Prof. S. K. Ghosh, Biotech.
Prof. T. K. Maiti, Biotech.
Prof. B. Adhikari, Mat. Sc. Centre
Prof. D. Bhattacharyya, Mat. Sc. Centre
Prof. G. B. Nando, RTC
Prof. A. Barua, Electrical Engg.
Prof. S. Maka, Electrical Engg.
Prof. S. Chopra Chatterjee, HSS
Prof. S. Dasgupta, Civil Engg.
Dr. S. K. Sharma, EKO X-Ray and Imaging Institute, Kolkata
Dr. S. Kundu, EKO X-Ray and Imaging Institute, Kolkata
Dr. M.K. Das, Variable Energy Cyclotron Centre, Kolkata
Dr. S. Pal, Variable Energy Cyclotron Centre, Kolkata
Dr. T. Bandopadhyay, Variable Energy Cyclotron Centre
Dr. M. N. Bandopadhyay, Cancer Centre Welfare Home and Research Institute, Kolkata
Dr. P.S. Soni, BARC, Mumbai
Dr. Debatosh Datta, Green Cross Therapeutics Pvt. Ltd., Kolkata

Additional faculty members may be inducted into the list depending upon the requirement of the course.

## **Selected project topics of the students graduating in the year 2005**

Dr. Subha Narayan Rath, "Comparison of chondrogenesis in different scaffold structures and culture condition", Division of Bioengineering, National University of Singapore

Dr. Bibhukalyan Prasad Nayak, "Developing and characterizing a polymer scaffold for ligament / tendon tissue engineering", Division of Bioengineering, National University of Singapore

Dr. Bijoy Chandapillai Karikkenth, "Tissue Engineering of cardiac grafts and study of related growth and differentiation factors", Institute of Experimental and Clinical Pharmacology and Toxicology, Friedrich-Alexander-University of Erlangen-Nuremberg, Germany

Dr. Deepak Kumar K K, Functional role of whisking and the somatosensory cortex", Brain Science Institute, RIKEN, JAPAN

Dr. Vijay Narayan Tiwari, "Development of radioactive injectable oxygen system for clinical oxygen metabolism studies using positron emission tomography", BIRC, University of Fukui, Japan

Dr. M. S. Jithendra Kumar, "A prospective study of assisted reproductive techniques in male factor infertility", Infertility Division, Ramesh Hospital, Bangalore, India

## **Facilities at SMST**

The students have access to some of the finest facilities available in the country for interdisciplinary research and development activities some of which are:

### **1. Medical Biotechnology**

#### ***Cell and Molecular Biology***

- DNA finger printing
- Electroporator
- Hybridizer
- Horizontal gel electrophoresis systems
- Gel documentation set-up
- Southern blotting apparatus
- PCR machine
- Sequencing facility
- Fluorescence and inverted microscopes
- UV cross linker
- Dark/cold room/radio-isotope facilities

#### ***Bioinformatics and Proteomics***

- Silicon graphics workstation
- Various softwares for protein analysis (RASMOL; RASWIN)
- HPLC
- Sonicator
- Western blotting apparatus
- ELISA reader

- Scintillation counter
- Vertical gel electrophoresis systems
- Lyophilizer
- Sequencing gel apparatus

## **2. Biomechanics and Biomaterials**

- Surface tension and contact angle measuring device
- Universal Testing machine
- Torque rheometer
- Viscometer
- Knee-joint simulator
- Profilometer
- FT-IR and UV-vis spectrophotometer

## **3. Telemedicine**

- Servers and workstation
- Video conferencing unit
- Telemedicine software supporting live medical teleconsultation related to cardiology/ radiology/ pathology/oncology/ tropical diseases over ISDN and lease lines and integration with various medical instruments for diagnosis and treatment

## **4. Biomedical Instrumentation**

- ECG and EEG recording systems with test probes
- PC based spirometer
- Ultra sound scanner
- Fetal monitor
- Electronic stethoscope
- Pulse oximeter and blood gas analyzer
- 8-channel biopotentials recorder

### ***Shared Facilities at Central Research Facility (CRF)***

- MALDI-ToF Mass Spectrometry
- Automated DNA Sequencer
- Real Time PCR Machine
- 2D Gel Electrophoresis
- Fluorescence Activated Cell sorter
- Scanning and Transmission Electron Microscope
- Atomic Force Microscope

### **Thrust Areas in Research**

- Immunophenotyping of cervical cancer
- DNA damage and infertility
- Injectable male contraceptive development
- Technological evaluation of copper T and tubal rings
- Tissue growth on surface modified titanium alloys
- Telemedicine and Hospital Information System
- Analysis, storage and retrieval of medical images
- Decision support systems in medicine

- Bioinformatics and genomics
- Drug design and delivery

### Ongoing Research

In the field of Medical Biotechnology, exhaustive *in vitro* studies on the generation of free radicals; lipid peroxidation; sperm membrane integrity and related functional tests and oxidative stress induced DNA damage in spermatozoa of male infertile subjects reporting for ICSI mode of treatment are being investigated. This methodical study, the first of its kind in India, will provide a platform to evaluate the risks of using ICSI for easy conception in the Indian scenario. Another project involves the study of cell-mediated immunological alterations by flow cytometric analysis of peripheral blood and tissue infiltrating lymphocytes and correlating the subsequent changes with various stages of the disease. Immunomodulation and anti-cancer effect of polysaccharides and lectins and their synergistic effect in combination treatment with anti-cancer drug is also being investigated. Genomic and proteomic analysis of protozoan parasites is being extensively studied.

Research work in the field of Bioinformatics include study of molecular dynamics of biomembranes, effect of alcohol and computer simulations of membranes, structure-function link in biological systems and structure of prion protein isoforms (3-D structure). Synthetic studies on anti-cancer (DNA cleaving agents), antibacterial (beta-lactamase inhibitors) and antiviral drugs are also being examined.

In-patient medical data is being collected from the B.C.Roy Technology Hospital to prepare a database of diseases (along with its ICD-10 classification) prevalent here for Telemedicine support. The database is being linked with other sites (e.g., SMST) to deliver multimedia resources and to provide electronic fora for facilitating communications across widely scattered research / teaching sites. The Computer Science and Engineering Department has established a Telemedicine network in West Bengal and Tripura connecting leading hospitals in the states to district hospitals. The telemedicine network supports remote teleconsultation for large variety of diseases including radiology, tropical diseases, cardio-vascular disorders, cancer etc.

The present ongoing research activity related to Biomedical Instrumentation deals with predictive monitoring of cardiovascular risk factors using non-invasive and cost-effective techniques. A low cost Doppler ultrasonography System has been developed at the Computer Aided Design Laboratory of Department of Electronics & Electrical Communication Engineering, this is in the process of being refined further. A few chipsets (DXT, DWT, CDWT & ADC) have been designed and implemented on FPGA for signal processing, image compression and telemedicine purposes. Work on hearing aids and automated glucose analyzer are also in progress. 3-D image analysis, tomography, image visualization and data compression with fractals and wavelets are some of the research interests of the faculty associated with SMST. Development of low-cost non-invasive electrical impedance imaging is also being planned. Changes in the dielectric properties of excised cancerous and benign tissues are being studied. A major thrust area of research in SMST is the injectable male contraceptive development which has reached advanced clinical trials. The School is also engaged in the development of a novel surgical injection device with imaging and force feedback active guidance. Problem-solving at a National level regarding contraceptives in mass usage (especially IUDs) is another ongoing activity.

The Biomaterials and Biomechanics group is working on acetabular cuff development with composites, fast-setting in-situ polyurethane composites for orthopedic applications, dendrimers with reduced bacterial infection, polymeric biosensors having in-built dendrimers fluorescent moiety and new polymer development such as toughened epoxy, composites such as carbon or

Kevlar reinforced HDPE, UHMWPE having greater biocompatibility, soft rubber and latex for biomedical applications and the development of plasma sprayed hydroxyapatite coated metallic substrates for orthopedic implants. The Biomechanics group is working on simulation of knee and hip joints, walk simulator and parametric modeling of musculo-skeletal system (human gait and spine movements). Another research group is investigating adherence, proliferation and differentiation of silk based biomaterials (biofilms and scaffolds). In addition, a state-of-the-art Tissue Engineering laboratory is being set up. Revascularization and reperfusion of ischemic tissues through Controlled Therapeutic Angiogenesis (CTA) is an ongoing research project.

### **Eligibility for MMST**

The programme is open for MBBS (recognised by Medical Council of India) graduates with a minimum of 55% marks in aggregate. The candidates must have studied Mathematics at +2 level (passing +2 level Mathematics as additional subject from National Open School or State Boards is also permitted). Seats are reserved for SC/ST candidates and persons with disability as per Government of India rules.

### **Test Centres**

Bangalore, Bhubaneswar, Chennai, Kanpur, Kharagpur, Kolkata, Mumbai, New Delhi and Visakhapatnam.

### **Application Forms**

The Application Form, Admit Card Format and the Information Brochure are available on the website <http://gate.iitkgp.ac.in/mmst/> from **30 Jan 2006**. The candidates can download the application form and send the completed application form with a demand draft for the non-refundable application fee of Rs. 1000/- (Rs 500/- for SC/ST category) in favour of 'IIT Kharagpur' payable at any Nationalised Bank in Kharagpur. Alternatively, the candidate can contact GATE Office IIT Kharagpur for an application form. Last date for the application forms to reach the following address is **27 Feb 2006**.

**Application form duly filled in should reach The Chairman, GATE, IIT Kharagpur 721302 by February 27, 2006.**

Candidates who purchase the application form from the GATE Office IIT Kharagpur have to ensure that they submit :

- Application Form completed in all respects.
- Copy of SC/ST Certificate if applicable.

Candidates who choose to download the application have to send, additionally, the demand draft as mentioned above.

### **Admit Card**

Admit Card is issued only to eligible candidates who submit the application form complete in all respects before the closing date. It should normally reach the candidates by **22.03.2006**. If it is not received by this date, the Chairman GATE IIT Kharagpur should be contacted for necessary action. The admit card should be preserved by the candidate even after the examination for the purpose of counseling.

### **Admission Test**

The admission test is of objective type to identify the aptitude of the candidates for a programme like MMST. The test is of two hour duration and held between 10.00 hrs. and 12.00 hrs. on **2 April 2006 SUNDAY**. The candidate needs to answer 120 questions of one mark each (no negative

marking) out of which 75 questions are assigned to the typical MBBS syllabi. The remaining questions are equally distributed to cover the syllabi of +2 level Physics, Chemistry and Mathematics. In case of tied ranks, the candidate with fewer wrong answers will be placed at a higher rank.

## **Syllabus**

### **Physics**

Newton's laws of motion, translation and rotation, energy and power, conservation of linear momentum, simple harmonic motion, Hook's law, First law of thermodynamics, expansion of solid, Gas laws, Maxwell distribution of velocity, waves, Interference of two waves, total internal reflection, Coulomb's law, Ohm's law, Magnetic Field due to Current, Faraday's law of induction, Photoelectric effect, Bohr model of atom, Radioactivity.

### **Chemistry**

Chemical equilibrium, Chemical and enzyme kinetics, Nuclear Chemistry, Enzyme catalysis, Coordination Chemistry - preliminary concepts, Bonding. Strong and weak interactions, Inductive and resonance effects on acidity and basicity, Characteristic reactions of alcohols, aldehydes, ketones, amines, carboxylic acids and their derivatives. Optical isomerism of compounds containing two asymmetric centers. Aromatic and heterocyclic compounds (one hetero atom), Carbohydrates, Amino acids, Nucleic acids and Proteins: general structure and physical properties.

### **Mathematics**

Algebra of complex numbers. Theory of quadratic equations and quadratic expressions, relationship between roots and coefficients. Arithmetic, geometric and harmonic progressions. Equation of a straight line in various forms, angle between two lines, distance of a point from a line, lines through point of intersection of two lines. Limit, continuity and derivative of a function, limit, and derivative of sum, difference, product and quotient of two functions and composite functions. Integration as the inverse process of differentiation, integration by parts.

### **Medical Science**

Anatomy - gross and applied, Physiology, Biochemistry and Genetics. Pharmacology : emphasis on clinical pharmacology, Pathology including microbiology and parasitology - emphasis on microscopic structures. Social and Preventive Medicine : emphasis on infectious and communicable diseases, immunization and family planning, Medicine including Pediatrics, Surgery including Orthopaedics and Urology, Obstetrics & Gynaecology, Ophthalmology and ENT, Anaesthesia and Oncology, Radio-diagnosis

## **Counseling**

On the basis of performance in the written test a list of qualified candidates will be prepared and these candidates are called for counseling at IIT Kharagpur on **June 9, 2006, FRIDAY** before final selection is made for admission.

### **Important Dates for MMST 2006**

Commencement sale of Appl. Forms	30-01-2006	<b>Date of MMST Exam 2006</b>	<b>02-04-2006</b>
Last date for		Announcement of Results	12-05-2006
Request by Post	24-02-2006	Counselling at IIT Kharagpur	09-06-2006
Sale at IIT Kharagpur GATE Office	27-02-2006	Tentative date of MMST admission	20-07-2006
Receiving completed Appl. Forms	27-02-2006		

Further information about MMST can be obtained from:

The Head	The Chairman
School of Medical Science and Technology	GATE
Indian Institute of Technology Kharagpur	Indian Institute of Technology Kharagpur
Kharagpur 721302 (WB)	Kharagpur 721302 (WB)
Phone: (03222) 282221	Phone: (03222) 282091
Fax: (03222) 255303, 282221	Fax: (03222) 278243
Website: <a href="http://ww.iitkgp.ernet.in/mmst/index.html">ww.iitkgp.ernet.in/mmst/index.html</a>	Website: <a href="http://gate.iitkgp.ac.in/mmst/">http://gate.iitkgp.ac.in/mmst/</a>
Email: <a href="mailto:officesmst@smst.iitkgp.ernet.in">officesmst@smst.iitkgp.ernet.in</a>	E-mail: <a href="mailto:gate@adm.iitkgp.ernet.in">gate@adm.iitkgp.ernet.in</a>

### **General instructions for MMST admission test**

1. Candidates are advised to occupy their assigned seats 15 minutes prior to commencement of the admission test. Candidates will not be permitted to enter examination hall after 15 minutes from the commencement of the test.
2. All questions are of objective/multiple-choice type. There is no negative marking. Each question has four options out of which only one is correct. The candidate should indicate his/her choice by clearly writing the correct option, viz. (A), (B), (C) or (D) in the space provided in the Answer Sheet at the end of the Question paper-cum-Answer book.
3. The use of calculator, electronic diary, cell phone, pager, etc. is not permitted in the examination hall. Exchange of stationary items is strictly prohibited.
4. Candidates are required to write the name, registration number, and the Examination Centre in the space provided on the cover page of the Question Paper-cum-Answer book and also their registration number only in the Answer Sheet at the end of the Question paper-cum-Answer book.
5. Candidates are required to put their signature in the space provided on the cover page and on the Answer-Sheet of the Question Paper-cum-Answer book.
6. Candidates are instructed not to remove any sheet from the Question Paper-cum-Answer book. All rough work should be done only on the blank pages provided in the Question Paper-cum-Answer book. No supplementary sheet will be provided.
7. Once the test starts candidates will not be allowed to leave the examination hall for any reason till the test is over and all other formalities are completed.
8. Candidates are required to remain seated after completing the test. The invigilator will collect the Question Paper-cum-Answer book. Candidates will be allowed to leave the examination hall only after the Question Paper-cum-Answer books from all the candidates have been collected.
9. Additional instructions given on the Question Paper-cum-Answer book should be strictly followed.

*Candidates found violating the instructions of the Test and/or that given by the invigilator will be disqualified. A candidate found assisting any other candidate or seeking/receiving help from any source in answering questions or copying in any manner in the test would forfeit his/her chance of being considered for admission.*