Information Brochure

Ph.D.

2007-2008

Indian Institute of Technology Bombay

Indian
Institute of
Technology
Bombay

Information Brochure
Ph.D.
2007-08

Important Information:

1. **PLEASE READ THE INSTRUCTIONS GIVEN IN THE BROCHURE CAREFULLY BEFORE YOU FILL IN THE APPLICATION FORM.**

2. Candidates applying for Ph.D. Programme can give preference for **THREE** Departments / Interdisciplinary Groups / Centres / Schools in one application form. For further choices, if any, additional forms may be used. **Application forms for admission to Ph.D. Programme can be obtained & submitted throughout the year, however, such applications will be processed twice in a year (i.e. Autumn and Spring Semester).**

3. Along with the Application form, candidates are provided with the following.

   a) Information Brochure

   b) Statement of Purpose Form
   (Candidates applying to Shailesh J. Mehta School of Management are required to submit a sample of recent published writings by the candidate on a relevant topics or a 1500 word essay or proposal on the topic of research interest in place of Statement of Purpose).

   c) Forms for recommendations (Two)

4. Application form & Information Brochure, Statement of Purpose (SoP), and Forms for Recommendations are also available on our website.

- **Please mail the completed application form (in a big size envelope 26 cm x 12 cm without folding the application form and attached documents) to the following address:**

  Deputy Registrar (Academic)
  Indian Institute of Technology Bombay
  Powai, Mumbai – 400 076.

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Website: **www.iitb.ac.in/admissions**

E-Mail address: pgadm@iitb.ac.in

Telephone No. : 022-2576 7066

Fax : 022-2576 4041

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	Sciences Department	
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	a) Registration and Orientation Programme	19-07-2007 to 20-07-2007
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(A) GENERAL

1) THE INSTITUTE

The Indian Institute of Technology Bombay (IIT Bombay) is one of the seven higher Institutes of Technology in the country set up with the objectives of making available facilities for higher education, research and training in various fields of Science and Technology. IIT Bombay established in 1958.

The Institute is located at Powai in a campus extending over 220 hectares amidst picturesque surroundings with Vihar and Powai lakes on either side.

At present, Undergraduate, Postgraduate and Doctoral programmes are offered in Aerospace, Chemical, Civil, Computer Science and Engineering offers regular M.Tech., PGDIIT (only IT) and Ph.D. programmes, Earth Sciences, Electrical, Mechanical and Metallurgical Engineering and Materials Science Departments as well as by certain Interdisciplinary groups i.e. Corrosion Science & Engineering, Energy Systems Engineering, Industrial Engineering & Operations Research,Reliability Engineering and Systems & Control Engineering. The Industrial Design Centre of the Institute offers Ph.D. Programme in Design and 2-year M.Des Programme in Industrial Design, Visual Communication, Interaction Design and Animation whereas M.Sc. and Ph.D. programmes in Applied Geology, Chemistry, Mathematics, Physics and M.Sc. programme in Applied Statistics and Informatics are offered by the respective Departments. The Department of Physics also offers 4-Year B.Tech. Programme in Engineering Physics. The Institute has a Humanities and Social Sciences Department, which offers doctoral programmes and 2-years M.Phil programme. The Institute has 2-Year M.Tech. Programme in Natural Resources Engineering in its Centre of Study in Resources Engineering (CSRE).

From the academic year 2007-08, Department of Computer Science & Engineering and Kanwal Rekhi School of Information Technology have merged and a new entity has been formed named “Department of Computer Science & Engineering”.

From the academic year 2007-08, the Institute has also started following new programmes.

1). Ph.D in Natural Resources Engineering - Offered by CSRE
2). M.Tech in Petroleum Geoscience – offered by Earth Science Department
3). M.Tech in Technology and Development – offered by CTARA

The Shailesh J. Mehta, School of Management offers a 2-years Master of Management programme and also a Doctoral programme. The School of Management also conducts a wide range of courses for the Undergraduate and Postgraduate Programmes. The School of Biosciences and Bioengineering offers M.Sc. (Biotechnology), M.Tech (Biomedical Engineering) and Ph.D. programme
.

The DIIT Programme (Post Graduate Diploma of IIT) contains courses that are a subset of the M.Tech. Programme with a provision for a mini project. The duration of the DIIT program is of one year. Now, this programme is also offered through Distance Education mode.

The Institute on an average admits 650 candidates for the Undergraduate programmes and 1050 candidates for different Ph.D / Postgraduate programmes every year. Students from Bangladesh, Egypt, Ethiopia, Fiji, Iran, Iraq, Jordan, Mauritius, Malaysia, Nepal, Palestine, Sri Lanka, Vietnam and Yemen are also undergoing training in various programmes. Apart from these students from developed countries such as France, Germany and USA are also coming to IIT Bombay for doing some courses / projects. Large number of students from other engineering colleges are also coming to IIT Bombay to do their B.E. / B.Tech. / M.E. / M.Tech. Projects. In addition to these academic programmes, the Continuing Education Programme (CEP Cell) organizes short, intensive courses in specialized topics both for practicing engineers as well as for teachers from engineering colleges; and also conducts seminar and conferences on current scientific and technological developments. Further, under Quality Improvement programme (QIP), teachers from various engineering colleges also join Institute for the postgraduate and doctoral programmes.

2) **RESEARCH FACILITIES**

All the departments of the Institute have well equipped research laboratories and workshop facilities. In addition, there are a number of central facilities, which include Computer Centre, Central Library, Workshop, Xerox and Photography Sections. The Central Library has a very large collection of books, back volumes of periodicals, standard specifications and other literature. The Library has now more than 3 lakhs books and volumes and subscribes to over 1500 current journals in Science, Engineering, Humanities and Social Sciences.

The Centre of Studies in Resources Engineering (CSRE) established by the Department of Education, Ministry of Human Resources Development, Govt. of India, offers M.Tech. Programme in Natural Resources Engineering. The CSRE is concerned with the area of Remote Sensing pertaining to natural resources exploration, exploitation and management

The Centre for Research in Nano-Technology & Science (CRNTS), which has been set up in collaboration with the Defence R & D Organization (DRDO), is engaged in research and development of electronic components.

The Center for Environmental Science and Engineering (CESE) funded by the Department of Education, Govt. of India, is concerned with air and water quality management, Computer Added Design for wastewater engineering systems, low waste techniques, etc.

The Centre for Technology Alternatives for Rural Areas (CTARA) is concerned with the development of technologies according to perceived needs of the Konkan rural region.

The Computer Aided Design Centre (CAD Centre) has been established with an aim to inculcate CAD culture in the Indian Chemical and Metallurgical Industry.

Established in 1969, the Industrial Design Centre has followed an integrated and interdisciplinary approach towards design education. The centre over the past years has experimented with different methods in design education to develop a flexible structure to suit the needs of students.

Schools in Cryogenics, Lasers and Laser Systems, Offshore Engineering and Management have also been established. New facilities under the Thrust Area Programmes in the fields like Microelectronics, Microprocessor Applications, Intelligent Systems, Robotics, CAD / CAM, Remote Sensing, Telematics, etc. have been created.

Centre for Aerospace Systems Design & Engineering (CASDE) and Centre for Formal Design and Verification of Software (CFDVS) have been established recently.

The Institute has many research collaborations with leading universities in USA, Europe, Japan, and other East countries. As part of these collaborations, the post graduate students get opportunities to carry out joint research projects with faculty and students from these universities.

Approximately 7 to 10 M.Tech. projects will be taken up every year in collaboration with German Academic Exchange Service (DAAD) wherein students work on their projects in reputed German Universities like Aachen, Berlin, Darmstadt, Karlsruhe, Stuttgart and Dresden.

The location of IIT Bombay in close proximity to several leading R & D Centers and major industrial establishments offers excellent opportunities to interact with them and plan some of research programmes in collaboration with them. The Industrial Research and Consultancy Centre (IRCC) coordinates collaborative projects with industry and other research organizations such as BARC, TIFR and CSIR. The Institute is actively collaborating with several organizations of other countries on a bilateral basis.

3) **STUDENTS AMENITIES**

Institute is fully residential and has 13 hostels for students. Each hostel is an independent entity with its own mess facilities, recreation areas, etc. However students may be permitted to have their own arrangements for accommodation outside campus.

Extra curricular activities are provided by the Students' Gymkhana. These activities include sports, cultural programmes, social service and the NCC. Various clubs of the Gymkhana encourage individual talents of students in hobbies such as painting, modeling, music, photography, aeromodelling and fabrication of electronic devices. A swimming pool is an additional facility. A well-planned student Activities Centre is functioning.

4) Ph.D. PROGRAMME

As a result of the sound research base and extensive infrastructural facilities available, the Institute offers Ph.D. programme in a wide range of areas in Engineering, Science & Humanities and Social Sciences. The broad objectives of the Ph.D. programme is not only to keep pace with the expanding frontiers of knowledge but also to provide research training relevant to the present social and economic objectives of the country.

The academic programme leading to the Ph.D. degree is broad-based and involves a minimum course credit requirement and research thesis. The Institute also encourages research in interdisciplinary areas through a system of joint supervision and interdepartmental group activities. The presence of a strong research oriented faculty provides excellent opportunities for such programme. The Institute undertakes sponsored research and development projects from industrial and other organizations in public as well as private sector.

Facilities for research work leading to the Ph.D. degree are available in the departments of Aerospace, Chemical, Civil, Computer Science and Engineering, Electrical, Mechanical and Metallurgical Engineering and Material Sciences, Chemistry, Earth Sciences, Mathematics and Physics as well as in the department of Humanities and Social Sciences, Shailesh J. Mehta School of Management (SJMSOM), School of Bioscience & Bioengineering (SBB), Centre for Environmental Science and Engineering (CESE), Industrial Design Centre (IDC) and Centre of Studies in Resources Engineering (CSRE).

5) MINIMUM QUALIFICATIONS FOR ADMISSION

One of the following in appropriate areas:

1) First class or equivalent Master's Degree in Engineering / Technology.
2) A First class Master's degree in Science (55% for SC/ST) or a first class in Bachelor's degree in Engineering / Technology (55% for SC/ST) and a valid GATE score or an award of a CSIR / UGC / NBHM / DBT Research fellowship.

Candidates not having a valid GATE score or CSIR / UGC / NBHM / DBT award can be considered for admission to the Ph.D. programme if they have minimum of 2 years of professional work experience in lieu of GATE score, **however, they will not be considered for Teaching/ Research Assistantship.**

5.1 **Humanities & Social Sciences:**

First Class or 60% marks (55% for SC / ST) in :

i) M.A. / M.Com. or equivalent degree. or
ii) Master's degree in Science / Graduate Degree in Engineering / Technology may be considered for research areas consistent with the academic background and special interests. or
iii) M.Phil. degree in any of the five disciplines (pertaining to the research areas listed below) or in any allied subjects or in "Humanities and Social Sciences with specialization in Planning and Development" awarded by IIT Bombay equivalent letter grade at the master's degree level.

5.2 **SJM School of Management**:

i) B.E. / B.Tech. or equivalent with first class (55% for SC / ST) and minimum of 2 years of relevant work experience. M.E. / M.Tech. or equivalent degree with first class at graduation and post graduation level (55% for SC / ST).
ii) Master of Management/M.B.A. or equivalent with first class at graduation and post graduation levels (55% for SC/ST).
iii) M.Sc. / M.A. / M.Com. / LLM / MCA or equivalent with first class or 60% at graduation and post graduation levels (55% for SC/ST) and 2 years of relevant work experience.

5.3 **Industrial Design Centre (Ph.D. Programme in Design)**:

FIRST CLASS or 60% marks (55% for SC/ST) in :
M.Des. / M.Arch. / M.Tech. / M.Phil. / MFA / Post-Graduate Diploma in Design of NID and equivalent or
B.Des. / B.Arch. / BFA / MA / M.Sc. / Under-Graduate Diploma in Design of NID, Ahmedabad or equivalent degree with exceptionally outstanding design related work with a valid CEED score.

Candidates with a minimum of three years of relevant professional experience without CEED scores can also be considered. However, such candidates will not be awarded Teaching / Research Assistantship.

This is general eligibility criteria, however, applicant must satisfy the eligibility criteria specified by the respective Departments / Centres / Schools/ ID Groups in this brochure. Wherever First class is requirement for eligibility, five percent relaxation is permissible to SC / ST applicants.

6) **CATEGORIES OF Ph.D. CANDIDATES**

Duration of the programme : Minimum 2 yrs. from the date of registration (3 yrs. For External candidates) & Maximum 6 yrs.

However, fellowships will be payable for duration fixed by the MHRD or date of submission of thesis, whichever is earlier.

The Institute admits Ph.D. candidates under the following categories:

6.1. **Full-time Research Scholar:**

i. Institute Research Scholars with Teaching Assistant-TA
ii. Govt. / Semi Govt. Fellowship Awardees (QIP, CSIR, UGC, DAE, DST, DBT, NBHM, etc.)
iii. Sponsored candidates(SW)
iv. Self-financed (Indian/Foreign)/Study Leave (SF)
v. Indian Council for Cultural Relations (ICCR) Awardees (Foreign Students)

6.2. **Part-time Research Scholar:**

i. Institute Faculty / Staff (IS)
ii. Project Staff (PS)
iii. Research Assistants (RA)
iv. External candidates (Sponsored) (EX)
v. Candidates from Colleges / Educational Institutes (CT)

Full-time Research Scholar:

6.1.1 ***Institute Research Scholars (Teaching Assistants –TA):***
Students under this category are entitled for Institute Teaching Assistantship. (***Please refer Item No. 9 for financial support***)

6.1.2 ***Govt. / Semi Govt. Fellowship Awardees (QIP, CSIR, UGC, DAE, DST, DBT, NBHM, etc.)***:
These candidates are financially supported under various Govt. / Semi Govt. schemes.
The admission procedure and other requirements are same as applicable to Institute Research Scholars.

6.1.3 ***Sponsored candidates (SW)***:
These candidates are sponsored by recognized R&D organization for doing research work in the Institute on full time basis. Candidates are expected to be released for full time research work at the Institute for a minimum period of three years. **They will not receive any financial support from the Institute.** Sponsorship letter (Appendix I) should be attached to the application form.

6.1.4 ***Self Financed (Indian / Foreign) / Study Leave (SF)***:
a) **Indian:** This category refers to persons with experience and with good track record to join the doctoral programme. They are admitted along with the regular research students through the usual admission

procedure but **they would not get any financial support from the Institute**.

If admitted, these students have to complete their programme without any financial support from the Institute, **however, they are required to do laboratory duties assigned by the Head of Department.**

b) **Foreign:** These students are admitted through Embassy of the respective Govt. after getting approval from the Ministry of External Affairs and no objection certificate from Ministry of Human Resources Development, Department of Education, Govt. of India.

c) **Study Leave:** This category refers to candidates who are released from Governmental or educational institutions on study leave for a period not less than three years for doing research work at the Institute. Employer's letter (Appendix II) should be produced at the time of joining, if selected.

6.1.5 ***Indian Council for Cultural Relations (ICCR) Awardees (Foreign Nationals) (FN)***:
These students are sponsored by their Governments and awarded scholarship by them. They should apply for admission through Indian Embassy in their country.

PART-TIME RESEARCH SCHOLAR

6.2.1 ***Institute Faculty / Staff (IS)***:
This category refers to candidates who are permanent employees of the Institute with more than 2 years of service left to their retirement are admitted to the Ph.D. Programme.

6.2.2 ***Project Staff (PS)***:
This category refers to candidates who are working on various Projects undertaken by the Institute and admitted to the Ph.D. programme, if the duration of the Project at the time of admission is around 3 years.

6.2.3 ***Research Assistantship (RA)***:
Depending upon the requirements, each Department / Centre / School may induct **one** Research Assistant every year.

Students under this category are entitled for Institute Research Assistantship.(***Please refer Item No. 9 for financial support***)

6.2.4 ***External Candidates (Sponsored) (EX)***:
After fulfilling one semester (M.Tech. / M.E. / equivalent) or two semesters (B.E. / B.Tech. / M.Sc. or equivalent) of residential

requirement at the Institute, these candidates will be allowed to register for Ph.D. with a supervisor from the Institute (Internal) and other from their parent organization (External) where they will be doing the research work. Sponsorship certificate from the organization (Appendix III) must be attached, to the application form.

6.2.5 Candidates from Colleges / Educational Institutes (CT):

a) ***They are carrying out Research work during week-ends, holidays and vacations, at IIT, Bombay.***

b) After fulfilling one (M.Tech. / M.E. / equivalent) or two semesters (B.E. / B.Tech. / M.Sc. or equivalent) of residential requirement at the Institute, these candidates will be allowed to register for Ph.D. with a supervisor from the Institute (Internal) and other from their parent organization (External) which is optional based on recommendations of the supervisor and respective DPGC / IDPC / PGC. Sponsoring certificate from the organization (Appendix-III) must be attached to the application form.

Candidates admitted under this category will be treated on par with Self-finance category as far as payment of fees and deposits are concerned.

c) Place of work will be IIT, Bombay even though candidate may be carrying out part of work at their College/Institute. These candidates are required to be available to the Supervisor (Internal) during week-ends, holidays and vacations.

7) ADMISSION PROCEDURE

7.1 Admission is offered on the basis of an interview held usually a month before the commencement of the semester for which admission is sought. The interview may be supplemented by a written test, if necessary.

Regular candidates called for the Test / Interview under Teaching Assistantship (TA) category only will be paid to and fro single second class railway fare by the shortest route from their place of residence to the Institute. They have to produce evidence (railway ticket number) in support of their claim.

No other categories of candidates are eligible for Traveling Allowance.

7.2 **Admission of External candidate (Sponsored) (EX):**

The candidates desirous of pursuing Ph.D. programme while in employment should apply for admission as external candidates. These applications should be made at the same time prescribed in the advertisement for regular candidates. **The minimum qualifications and other eligibility criteria for admission are the same as for regular full time students**. It should be noted that the Ph.D. programme of this Institute will be the same for both, for a regular (TA) student as well as for an external candidate. However, the

following additional conditions are to be noted/fulfilled by the external candidates.

7.2.1 The Institute will decide the competence of these candidates along with the regular candidates.

7.2.2 The following certificates must be submitted by the candidate along with the application form.

a) Sponsorship certificate from the organization in which he / she is employed, identifying the supervisors (internal and external) and giving an undertaking that the candidate would be released from his / her normal duties to fulfill the residential requirements. The prescribed format for the certificate is given in Appendix-III.

b) Details of facilities relevant to the research programme available in the organization, duly certified by the sponsoring authority.

c) A certificate stating that these facilities will be made available to the candidate by the organization.

7.2.3 The candidate is required to be in residence at the Institute during the first semester (second semester, if required) of his Ph.D. programme.

7.2.4 To promote interaction and association of the Institute Faculty and the external organization concerned, meeting between the two supervisors (internal and external) should be arranged at least once in a year in the Institute or in the sponsoring organization to ensure a continuous dialogue and participation in the joint supervision programme. These meetings could also be arranged during the stay of the candidate as mentioned in 7.2.3 above.

7.2.5 The Ph.D. registration of an external candidate would be reviewed at the end of each year from the date of registration in terms of his progress in courses / seminars / approved research programme by a Research Progress Committee (RPC) nominated by the concerned Department postgraduate Committee (DPGC) / Interdisciplinary Programme Committee (IDPC) / Postgraduate Committee (PGC) for School and Centre.

7.2.6 The facilities of external registration are for those who are working inwell-equipped scientific institutions, laboratories, R&D establishments and industrial organizations engaged in research based activities.

7.2.7 Persons working in colleges / universities are eligible for registration as external candidates, provided he / she fulfills the requirements stated under *7.2.1* to *7.2.3* above and produces a letter from the university (as in Appendix IV) stating that the university has no objection for IIT Bombay awarding the Ph.D. degree.

7.2.8 For fulfilling the residential requirements during the first semester, a candidate will have to produce a certificate from his / her employer that he / she has been fully relieved from normal duties during the semester(s) to complete the residential requirement at IIT Bombay. **This certificate is to be produced at the time of joining the programme.**

8) **PAYMENT OF FEES AND DEPOSITS**

Various fees and deposits for the programme are given in Appendix V.

9) **FINANCIAL SUPPORT**

Students joining Ph.D. programme will be considered for Teaching / Research Assistantship based on the following norms:

9.1 Institute Teaching Assistantship:

9.1.1 Those students having B.E. / B.Tech. / B.Arch / M.Phil. / B.Sc.(Engg)/ M.Sc. / M.A. / M.Com. or equivalent and who have either a valid GATE or National Level test–UGC / CSIR / NBHM / DBT etc. (JRF ship) will be considered for monthly assistantship of Rs. 8,000/- for first 2 years and @ enhanced rate of Rs. 9,000/- for remaining 3 years.

9.1.2 Those student having M.Tech. / M.E. / M.Arch / M.Sc.(Engg) or equivalent / M.B.B.S / MD / MS and Management students with M.B.A. qualification with Engineering / Technical background will be considered for monthly assistantships of Rs. 9,500/- for first 2 years and @ enhanced rate of Rs. 10,000/- for remaining two years.

9.1.3 Management students with M.B.A. qualification with Science / Commerce background will be considered for monthly assistantships of Rs. 8,000/- for first 2 years and @ enhanced rate of Rs. 9,000/- for remaining three years.

9.1.4 The assistantship is payable for maximum period of 5 years for candidates with B.E./B.Tech./M.Sc. as qualifying degree & maximum period of 4 years for candidates with M.E. / M.Tech. as qualifying degree or date of submission of thesis, whichever is earlier.

9.1.5 The above assistantship requires that the students must assist in teaching or research, as assigned by the Institute, **to the extent of 8 hours of work per week**.

9.2 Institute Research Assistantship:

9.2.1 Students with B.E. / B.Tech. / M.Sc. or equivalent qualification and valid GATE / CSIR / UGC / NBHM / DBT etc. (JRF ship) offer will only be considered for Assistantship.

9.2.2 The amount of monthly Assistantship for students who have B.E./ B.Tech./ M.Sc. or equivalent qualifications: Rs. 10,000/- for first two years and Rs. 11,000/- for next three years. The amount of assistantship for student who have M.E. / M.Tech. or equivalent qualification: Rs. 11,500/- for first two years & Rs. 12,000/- for next three years.

9.2.3 The assistantship is payable for maximum period of 5 years (irrespective of qualifying degree) or date of submission of thesis, whichever is earlier.

9.2.4 These Research Assistants have to look after the laboratories and also assist in teaching or research or other work assigned by the Head of the Department / Centre / School or Convener IDPC. **They are required to work for about 16-20 hours a week. They have to complete the Ph.D. programme in five years.**

The continuation of the assistantship(TA/RA) will be subject to satisfactory performance of the duties assigned by the Department / Centre / School as well as satisfactory academic performance.

As per MHRD directives, the employees of any organizations undergoing Ph.D. / Post-Graduate Programmes by availing study leave with or without pay are <u>not eligible</u> for Teaching/Research Assistantships. Such candidates, if found suitable, will have to complete their programme as Self Finance / Sponsored full time or part time, as the case may be.

Students getting assistantships (TA/RA) from the Institute can join projects sponsored by external agencies like Aeronautics Research & Development Board (ARDB), Department of Science & Technology (DST), Council for Scientific & Industrial Research (CSIR) etc. and obtain corresponding fellowships in lieu of TA/RA ship.

9.3 Other fellowships :

9.3.1 Few fellowships (@ Rs. 14,000/- per month) are also available in the department of Metallurgical Engineering & Materials Science, sponsored by the International Advanced Research Centre for Powder Metallurgy & New Materials.

9.3.2 Starting in 2007, applicants to Ph. D. IIT Bombay will also have an opportunity to opt for a co-badged Ph.D. Programme offered jointly by IIT Bombay and Monash University, Australia. Exceptional students will be enrolled at both the Institutions and they will have at least two supervisors, one in each Institute. The student admitted in IIT Bombay will be governed by the rules and regulations of the Senate of the Institute. The scholarship will be paid by the Monash University. The joint Ph.D. programme will initially apply to the Engineering and Science disciplines.

Candidates selected for the joint Ph.D. programme will be required to spend a minimum of 3 months for research work in Australia. after they have completed the required course work at IIT Bombay and the first Annual Progress Seminar Report formalities of the programme.

Scholarship support will be available for the IIT Bombay-Monash Ph.D. scholars for a maximum of 4 years in the programme. English language proficiency is an additional requirement of this programme.

Since this is the first year of the programme, the co-badged programme will be available only in select areas of research which will be announced at the time of selection for Ph.D.

10) REGISTRATION FOR THE Ph.D. DEGREE

After a candidate has been admitted to the Institute, he/she has to make an application on a prescribed form for registration for the Ph.D. degree. This application will be considered by the Departmental Postgraduate Committee (DPGC) / Interdisciplinary Programme Committee (IDPC) / Postgraduate Committee for Centre and School (PGC) which will make appropriate recommendations to the Senate regarding (a) the course work prescribed for the candidate and (b) the date of registration.
The period of validity of Ph.D. registration for all candidates is six years from the date of confirmation of registration. (Registration is confirmed as per rules, after successfully completion of course credit requirements).

11) SUBMISSION OF THESIS AND AWARD OF DEGREE

Subject to fulfilling the course credit requirements and other conditions as may be laid down from time to time, the candidate may submit the Ph.D. thesis after two years from the date of registration (3 years for external candidates).

The thesis is examined by two referees from outside the Institute. The Senate examines the reports of the referees and on acceptance of the thesis, appoints a Board of Examiners to conduct a viva-voce examination at which a candidate is required to defend the thesis.

On the basis of the report of the Board of Examiners, the Senate decides the students eligibility for award of the degree of Doctor of Philosophy.

(B) INFORMATION ON DEPARTMENTS AND INTERDISCIPLINARY AREAS, CENTRES AND SCHOOLS

In addition to the eligibility requirements given in 5, following are the eligibility requirements for admission for each Department / School / Centre/ Interdisciplinary group:

1. **DEPARTMENTS:**

1.1. **DEPARTMENT OF AEROSPACE ENGINEERING : AE**

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. B.Tech. / M.Tech. or equivalent degree in Aerospace or Mechanical Engineering. or
ii. B.Tech. / M.Tech. degree in other branches of engineering may be considered for research areas consistent with the academic background and special interests.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. **Aerodynamics** :
Boundary layer stability and control, Separated flows; Bluff body wakes; Drag, Jet flow interaction with obstacles; Shockwave boundary layer interactions; CFD for compressible and incompressible flow with heat transfer, Fluid-structure interaction, Finite volume time domain techniques in computational electromagnetics. Optimization in aircraft design. Aerospace vehicle stability and control analysis.

ii. **Dynamics and Control** :
Active and Adaptive control systems, Modeling analysis and control of linear and Non-linear dynamical systems, Flight control and simulation, Dynamics and control of flexible structures, Control design techniques and tools, Spacecraft attitude control.

iii.Aerospace Propulsion :
Aero thermodynamic analysis and engine sizing, Axial Flow, compressor design, cascade flow analysis, Combustion, CFD of internal flows, Microchannel cooling of gas turbine blades, Thermal signature analysis of aerospace powerplant, Aerothermal studies in hypersonics, Active and passive flow control in turbomachines.

iv. Aerospace Structures :
Mechanics of composite materials and structures, Vibration and Stability, Finite element methods of structural analysis, Aeroelasticity and Aero-servoelasticity, Structural optimization, Smart structures.

v. Systems Design and Engineering :
Aerospace system design methodology & tools, Integrated modeling & simulation, Mechatronics, Multidisciplinary design optimization, System synthesis through system integration, Mini aerial vehicle design and development.

1.2 DEPARTMENT OF CHEMICAL ENGINEERING: CL

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. B.Tech. / M.Tech. or equivalent degree in Chemical Engineering or
ii. B.Tech. / M.Tech. or equivalent degree in other branches of Engineering may be considered in areas consistent with the research areas of the department or
iii. M.Sc. in disciplines consistent with the research areas of the department.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. Computer Aided Design and Control :
Process Simulation & control; Optimization; Process Integration and Schedulling; Energy Conservation and Optimal Resource Management; Artificial Intelligence and Mathematical Modelling, multiscale modeling.

ii. Biochemical & Food Process Engineering :
Metabolic & Genetic Engineering; Biosepratrions; Bioinformatics; Systems Biology; Drug Discovery; Enzymology; Bioprocess Development; Vermiculture for Waste Mangement; Dehydration of Food Systems; Controlled Atmosphere Storage; and Process Development of Food Systems.

iii. Interface Engineering & Science :
Colloids; Sol-gels; Emulsions & Foams; Paints and Coatings, Nanoparticles; Microstructural Engineering; Aerosols; and Microscopy.

iv. Polymer Science & Material Technology :

Polymer materials; Polymer Reaction Engineering; Polyurethane, Rubber, Polymer Rheology, Ceramics; and Molecular simulation of Polymers.

v. Separation Technology :
Membrane Separations; Pressure Swing Adsorption; Supercritical Extraction; Bioseparation; Polymer Adsorption; Extractive Distillation; and Thermodynamics.

vi. Reaction Engineering :
Catalysis; Multiphase Reaction; Bioreaction Engineering.

vii. Multiphase Systems :
Fluidization; Granular flows; and Powder Mixing.

viii. Fluid Mechanics :
Low Reynolds number flows, Turbulence, Rheology of complex fluids.

ix. Environmental Engineering :
Waste Management; Pollution Control; Air Pollution Prediction & Control; and Vermiculture.

1.3 DEPARTMENT OF CHEMISTRY : CH

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
M.Sc. or equivalent degree in Chemistry / Physics / Biochemistry / Life Sciences / Pharmacy / Material Science / Biotechnology.

Candidates with masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

(i) Biophysical Chemistry
(ii) Coordination Chemistry
(iii) Bio-inorganic Chemistry
(iv) Organometallic Chemistry
(v) Bio-organic Chemistry
(vi) Chemistry of Natural Products
(vii) Synthetic Organic Chemistry
(viii) Photochemistry and Spectroscopy
(ix) Polymer Chemistry
(x) Thermodynamics
(xi) Electrochemistry
(xii) Solid state Chemistry and Physics

(xiii) Catalysis
(xiv) Theoretical Chemistry

1.4 DEPARTMENT OF CIVIL ENGINEERING: CE

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
(i) B.Tech. / M.Tech. or equivalent degree in Civil Engineering. or
(ii)B.Tech. / M.Tech. degree in any branch of Engineering or
(iii)M.Sc. degree in any branch of Science may be considered for research areas consistent with the academic background and special interests.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

(i) Transportation Systems Engineering :
Transport planning theory; Traffic flow theory and capacity analysis; Traffic control and management: DSS for urban transport operations; Land use and transport Planning models; Economics evaluation; analysis and Environmental Impact assessment of transportation projects; Urban and regional transport network modelling; GIS / ES / FUZZY / GA / ANN theory and applications to transport planning; Mass transport planning and design; Behavioral travel modeling.

(ii) Geotechnical Engineering :
Constitutive modelling of soil, Soil-structure interaction; Foundation for offshore structures, Earth dam problems; Rock Mechanics and tunneling; Soil dynamics; Soil stabilization; Expansive soils; Ground improvement; Reinforced soil structures and geosynthetics; Geotechnical centrifuge study; Optimization techniques and environmental geotechniques; Landslides.

(iii) Water Resources Engineering :
Real fluid flow problems; Turbulent flows; Flow stability, Computational hydrodynamics; Diffusion of Jets; Marin Outfalls; Stratified flows; Steady state and transient flow characteristics in openchannels; Fluid transients in closed conduits; Ground-water movement and recharge; Inverse modeling of large aquifer systems, Sea water intrusion in coastal Aquifer, Diffused and sharp interface models; Transport of pollutant in aquifers and aquifer remediation; Contaminant transport in surface waters; Problems of arid and humid zones; Optimization techniques in water resources engineering; Hydraulic structures; Inter-basin transfer; Urban water management; Urban water supply; Strom water and waste water treatment and disposal; Sedimentation in culverts / bridges; Flow around bridge piers; Water quality modeling; Fluid flow in large diameter pipelines; Analysis of random hydrological data.

Computational fluid dynamics; Hydro informatics; GIS and remote sensing applications in water resources; Finite elements and boundary element methods in environmental engineering and water resources.

(iv) Structural Engineering :
Finite element techniques; Concrete technology; Composite materials and mechanics, Reinforced and prestressed concrete, Steel structures, Strength, stability and dynamics of thin membranes, plates and shells, Structural optimization; Structural response to impact and shock loading; Pressure vessels; Reliability analysis, Probabilistic design methods; Curved grid, Cable networks; Plastic analysis techniques, Structural dynamics; Earthquake engineering; Earthquake disaster management; Computational mechanics; Wind effects on structures; Inverse problems and artificial intelligence applications; Offshore structures; Shell foundation; Structural health monitoring.

(v) Geodesy and Remote Sensing :
Development of methods and algorithms for digital analysis of Remotely Sensed Data (RSD); Digital Analysis of Thermal (IR) and Microwave RSD; Fuzzy and ANN approaches for RSD analysis; Digital Terrain Modelling (DTM); Remote Sensing, GIS and DTM in Hydrological Modelling; Decision Support Systems in Watershed Development; Cropland Suitability, Crop identification, acreage and yield estimation. Geodesy and space geodetic techniques; Global positioning system; Application of geodesy and GPS to earthquake studies; Geodesy for geodynamics; Space very long baseline interferometry.

1.5 DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING: CS

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
B.E. / B.Tech or M.E. / M.Tech or M.Sc. / MCA or an equivalent degree from a recognized university. Candidates without a masters degree in engineering are required to have a valid GATE score in order to be eligible for the assistantship provided by the Institute.

Eligible candidates will be called for a written test and interview. The written test will ascertain the mathematical, programming, logical and general aptitude of the candidates.

Candidates who are admitted to the Ph.D. programme will be required to pass a " qualifying" exam to continue to stay in the programme. Depending on the candidate's academic background, this will be given six months to one year after they join. Details regarding this examination can be found at http://www.cse.iitb.ac.in/phdqualifier.

* For admission to Ph.D to KReSIT refer to the admission criteria for CSE.
* This is in view of merger of academic programmes of CSE & KReSIT.

INDUSTRY SPONSORED FELLOWSHIPS

Some prestigious Industry-sponsored fellowships covering tuition fees and providing monthly stipends ranging between Rs.12,000/- and Rs.15,000/- per month and generous contingencies are available to meritorious Ph.D. students. Fellows are expected to produce high quality research leading to Conference and Journal Publications.

RESEARCH AREAS

(i) Algorithms
Algorithms and complexity; Combinatorics and graph theory; Geometric Algorithms.

(ii) Programming languages and Compilers
Theory of code optimization; Optimizing and parallelizing compilers; Analysis and implementation of functional and logic programming languages; Theory of programming languages.

(iii) Database and Information Systems
Object oriented, temporal and parallel databases; Query optimization and transaction management; Real time databases systems, indexing multidimensional data; Wide-area distributed database systems; data dissemination systems; data warehousing and database and application security.

(iv) Artificial Intelligence
Image Processing, Pattern Recognition and Computer Vision; Intelligent systems and their applications–tutoring systems, Natural language understanding; Machine learning and neural networks; Machine translation, Semantics Extraction; Document understanding; Cross lingual information Retrieval; Intelligent interfaces.

(v) Software Engineering
Object oriented software development; Component architectures. Re-engineering of software; systems analysis and design; MIS systems; Project management; Quality assurance.

(vi) Formal Methods
Formal specification, design and verification of hardware and software systems including distributed systems; Logic, automata theory and their applications in reasoning about systems; Automated theorem proving; Model checking; Reachability analysis of large and infinite state spaces; exact and approximate techniques.

(vii) Distributed Systems
Performance Evaluation, fault tolerance and scalability issues in distributed systems, Distributed object-based systems, Programming models and

Runtimes for generic agents, Parallel Computing, High performace cluster computing, Distributed operating systems, Self-configuration using abstract performance and capacity models of distributed component based applications, Topology based problem detection and root cause isolation in enterprise environments.

(viii) Computer Networks
Performance modeling, analysis and design of wired and wireless networks, Implementation and verification of network security protocols. Deployment, data management, communication and energy-efficiency issues in Sensor Networks, Design of content distribution networks for data dissemination, Architectures and protocols for metro optical networks, Network algorithms, Utility and Pricing models, Quality-of-service protocols, Mobile Computing, Voice Routing, Voice over IP, RFID networks, Enterprise networks, Access and Broadband networks.

(ix) Data Mining
Data integration models and algorithms, Graphical models, Information extraction and retrieval, Forecasting and smart e-business, Sensor and Bio-informatics data mining, Text and Web data mining. Integrated mining with relational DBMS, Temporal mining, Integrating mining with OLAP.

(x) Computer Graphics, Computer Vision and Image Understanding
Computer-aided graphics design; Multimedia; High Performance computing; Visualization; Rendering; Animation; Image and video retrieval; motion capture; point based methods.

(xi) Real-Time and Embedded Systems
Functional Programming Applications, Reconfigurable computing, Automobile Telematics, Embedded control units, Design and development of robots and sensor platforms

(xii) Formal Languages and Bio-inspired Computing
DNA, Membrane and Quantum Computing, Combinatorics on words.

1.6 DEPARTMENT OF EARTH SCIENCES: GS

ELIGIBILITY FOR ADMISSION:

First Class or 60% marks (55% for SC / ST) in :

(i) M.Sc. / M.Tech. / M.Sc.(Tech.) / M.Phil. (2-year) degree in Geology, Geophysics, Geochemistry or equivalent. or

(ii) M.Sc. / M.Tech. / M.Sc. (Tech.) / M.Phil. (2-year) degree in Physics, Chemistry, Mathematics, Life Sciences, Marine Sciences, Atmospheric Sciences or equivalent and having Geology / Physics / Geochemistry at the B.Sc. stage as principal subjects. or

(iii) Candidates with First class Postgraduate degree in Science / Engineering and employed in a field / research area related to Earth

Sciences may be considered for Ph.D. programme as external candidates, on a case-to-case basis depending on the research interest of the Department.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

(i) Geochemistry
(ii) Structural Geology
(iii) Igneous and Metamorphic Petrology
(iv) Hydrogeology
(v) Sedimentology
(vi) Micro-paleontology, Stratigraphy, and Petroleum Geology
(vii) Ore Petrology, Geostatistics / Ore Deposit Modelling
(viii) Isotope Geology
(ix) Remote Sensing / GIS
(x) Seismology
(xi) Geothermics
(xii) Mineralogy
(xiii) Electromagnetism
(xiv) Engineering Geology

1.7. DEPARTMENT OF ELECTRICAL ENGINEERING: EE

AREAS OF SPECIALIZATION

1. Communication Engineering
2. Control and Computing
3. Power Electronics and Power Systems
4. Microelectronics
5. Electronic Systems

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

(i) B.E. / B.Tech. / M.E. / M.Tech. or equivalent degree in Computer Science, Computer Science & Engineering, Computer Engineering, Electrical Engineering, Electronics, Engineering Physics, Telecommunication Engineering, Instrumentation Engineering, Biomedical Engineering. These candidates are eligible for research areas consistent with their academic background and special interests. or

(ii) Master of Science in Mathematics, Physics, Electronics with an interest in Electrical Engineering Sciences.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

AREAS OF SPECIALIZATION

Communication Engineering (EE 1)

- Communication System
- Communications Network and Internet
- Computational Electromagnetics
- Image Processing and Computer Vision
- Microwaves, RF and Antennas
- Multimedia System
- Optical Communication and Photonics
- Signal Processing
- Speech Processing
- Wireless and Mobile Communication

Control and Computing (EE 2)

- Linear Systems Theory
- Optimal Control & Optimization
- Systems Modeling & Identification
- Control of Distributed Parameter Systems
- Nonlinear Systems
- Modern Filter & Network Theory.
- Behavioral System Theory
- Computational Methods in Electrical Engineering

Power Electronics & Power Systems (EE 3)

- FACTS, HVDC and Power Quality
- Distributed generation
- Power System Restructuring
- Wide Area Measurements and System Protection
- EMI / EMC
- Coupled field computations
- Electrical Machines: modeling, analysis, design and control
- Special machines
- Power Electronics converters, electric drives
- Power Electronics for non-conventional energy sources

Microelectronics (EE 4)

- Devices & IC Technology
- Reliability studies in devices

- Semiconductor device simulation & modeling
- Organics semiconductor devices
- VLSI and system hardware design
- CAD Tools
- MEMS design and technology (including bio-MEMS)
- Flash memory devices

Electronics Systems (EE 5)

- Signal Processing Applications
- Speech Processing
- Electronic Instrumentation
- Biomedical Electronics

1.8 DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES: HS

ELIGIBILITY FOR ADMISSION

First class or 60% marks (55% for SC / ST) in :

i. M.A. / M.Com. or equivalent degree. or
ii. Master's degree in Science / Graduate Degree in Engineering / Technology may be considered for research areas consistent with the academic background and special interests. or
iii. M.Phil. degree in any of the six disciplines (pertaining to the research areas listed below) or in any allied subjects or in "Humanities and Social Sciences with specialization in Planning and Development" awarded by IIT Bombay or equivalent letter grade at the master's degree level.

RESEARCH AREAS

i. Economics :

Money, Banking & Finance, Economic Systems, Gandhian Thought, Managerial Economics, Applied Econometrics, Monetary Economics, Industrial Economics, Industry–Environment Linkages, Monetary Economics and International Finance, Multinationals and Technology Transfer, International Trade, Economic Reforms.

ii. English :

Modern Critical Theory, Aesthetics, Linguistics & ELT, Indian and Western Drama, Modern Literature, Creative Writing, Literature, Drama & The Contemporary Media and Conscientization method for language teaching, Novel, Victorian studies, Postmodern Literature and Intertextual theory, Syntactic theory, First language acquisition, Linguistic deficits, Language processing, Conservation of endangered languages (especially Dravidian minority languages), Women's Studies,

Autobiography Studies, "Crisis" in English Studies, African American Writing.

iii. Philosophy :

Cognitive Science, Logic, Philosophy of Language, Contemporary Western Philosophy, Meta-Ethics, Philosophy of Mind, Postmodern Theory, Political Economy, Post-Marxism, Buddhism, Classical Indian Philosophy, Comparative Religion, Comparative Philosophy, Vedanta Philosophy, Analytical Philosophy.

iv. Psychology :

Stress Management, Women's Studies/Psychology, Gender Roles, Social Psychology, Organizational Behavior, Human Resource Development, Organizational Behavior and Social Development, Social Psychology of Education, Crisis Management and HRD, Technology and Rural Development, Health and Clinical Psychology, Ergonomics, Culture and Ethics in Organization, HR issues in the B.P.O. industry in India.

v. Sociology :

Political Sociology, Sociology of Development, Rural Sociology, Environmental Sociology, Religion and Social Movements, Sociology of Contemporary India, Social Change, Family and Kinship, Urban Sociology, Ethnic Relations/Communal Violence, Sociology of Agriculture, Technology Adoption and Social Impact Assessment, Ethnically and Multiculturalism, Sociological Theory, Sociology of Gender, Sociology in India, Dalit Studies, Media and Culture.

vi. Other areas which pertains to Cell for Indian Science and Technology in Sanskrit (CISTS):

Sanskrit language, Paninian Grammar, Indian Philosophy of language, Aesthetics in Sanskrit Texts, Astronomy (Jyotisha), Mathematics (Ganita), Logic (Nyaya-sastra), Philosophy (Advaita-Vedanta), Meta-Physics, Self-development, Application of Non-linear dynamics.

1.9 DEPARTMENT OF MATHEMATICS: MA

ELIGIBILITY FOR ADMISSION:

First Class or 60% marks (55% for SC / ST) in :

i. M.A. / M.Sc. in Mathematics / Statistics / Computer Science or
ii. M.Stat.

Candidates with masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. **Algebra:**
Algebraic Geometry and Combinatorics (Schubert varieties, linear codes, varieties over finite fields), Commutative Algebra (Blowup algebras, Hilbert functions, local cohomology, projective modules, compete intersections).

ii. **Analysis:**
Functional Analysis (Operator Theory, unbounded subnormals, Hilbert modules), Numerical Functional Analysis (Approximate solutions of operator equations and eigenvalue problems, spline theory), Vector-valued functions (linear spaces, optimal recovery of functions, stability and well-posedness), Real Analysis, (Mean periodic functions, generalized integrals).

iii. **Combinatorics:**
Polyhedral combinatorics (approximation algorithms, combinatorial optimization) Posets (generating functions), Matroid Theory, (submodular functions, linear and integer programming, network flows).

iv. **Geometry & Topology:**
Algebraic Topology, Differential Topology (harmonic manifolds, matrix varieties).

v. **Number Theory:**
Representations of algebraic groups. Automorphic forms, L-functions, converse theorems, Representation theory of p-adic groups, Arithmetic of elliptic curves and Iwasawa Theory, Class numbers of quadratic fields, Diophantine equations.

vi. **Partial Differential equations and Numerical Analysis:**
Numerical Analysis, (Finite element methods, finite volume methods) Partial Differential Equations (Hyperbolic systems of quasilinear partial differential equations, non-linear waves, partial integro-differential equations, visco-elastic fluid-flow problems, Shock waves in hyperbolic systems of conservation laws.

vii. **Statistics and Probability:**
Computational Biology (Biostatistics, Bioinformatics), Statistical data mining in proteomics (probabilistic optimization problems in Molecular Biology), Reliability Theory, Industrial Statistics, Construction of reliability test plans, Statistical Inference (Geostatistics, modeling bivariate distributions), Stochastic Differential Game Theory, (Stochastic Control Theory, Mathematical Finance), Applied Probability, Statistical Inference (Poisson and compound Poisson approximations, estimation after selection).

1.10 DEPARTMENT OF MECHANICAL ENGINEERING: ME

ELIGIBILITY FOR ADMISSION

i. B.Tech. / M.Tech. or equivalent degree in Mechanical Engineering with first class (60% minimum) at UG & PG levels(55% for SC / ST).
ii. B.Tech. / M.Tech. degree or equivalent in Production Engineering / Industrial Engineering / Aerospace Engineering with first class (60% minimum) at UG & PG levels (55% for SC / ST) may be considered.
iii. B.Tech. / M.Tech. Degree in other branches of Engineering / Technology with an outstanding academic record may also be considered for research areas consistent with their academic background and special interests of the Department.

Candidates with bachelors degree in engineering must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. **Heat Transfer and Thermodynamics :**
Convective and radiative heat transfer, Thermal Insulation, Transport properties, Combustion, Solar energy, Numerical techniques.

ii. **Refrigeration and Airconditioning :**
Refrigeration systems, A.C. systems, Cryogenics, Miniature Cryorefrigerators, Absorption systems, Food preservation, Liquification systems.

iii. **Internal Combution Engineering :**
Fuel injection problems, Performance studies on petrol and diesel engines, Alternate fuels, Emission studies.

iv. **Thermal Power Engineering :**
Power plant analysis and design, Nuclear engineering, Nuclear reactor heat transfer, Reactor physics problems, Isotope applications and nuclear techniques.

v. **Fluid Power :**
Fluid mechanics, Fluid Machinery, Fluid power control, Microfluidics.

vi. **Combustion and Flames :**
Laminar and turbulent flame propagation, Flame stabilization, Studies with vitiation of combustion air, Combustion in closed vessels, Fluidised bed combustion.

vii. Automatic Control :
System modeling, Optimal control, Model reduction techniques, Computer control, Microprocessor based control and automation, Digital control techniques, Computer vision based control in automation and Robotics.

viii. Computer Aided Design :
Simulation optimization, Interactive graphics.

ix. Stress Analysis:
Photoelasticity, Analytical methods based on complex variables, Numerical methods – Finite element and boundary element methods, etc.

x. Fracture & Fatigue :
Linear elastic fracture mechanics, Elastic-plastic fracture mechanics, Fracture of composites, Dynamic fracture, 3-D problems of fracture, Low and high cycle fatigue, Creep, Corrosion, Creep-fatigue interactions, Fatigue-creep-corrosion interactions, Finite element and boundary element method applications.

xi. Vibration, Noise, Acoustics and Dynamics :
Linear and non-linear vibrations, Chaotic vibration, Vehicle dynamics, Switchgear dynamics, Rotor dynamics, Acoustics and noise control, Finite element and boundary element method applications, Nondestructive method for crack detection.

xii. Robotics, Kinematics and Control :
Analysis and optimal synthesis of planar and spatial mechanisms, Error analysis and calibration of robots, Programmable mechanisms, Identification and nonlinear control of rigid and flexible manipulators, Design issues related to wakling and running robots and mechanical logic gates.

xiii. Design Engineering :
Gears, Pressure vessel design, Tribology and lubrication, Machinery maintenance, Optimization, CAD, Textile Machinery.

xiv. CAD / CAM / CIM, CNC, Computer Assisted Process Planning, Design for Manufacturing and Assembly, Manufacturing Automation & Control, Intelligent Manufacturing Systems, Rapid Prototyping and Tooling.

xv. Design, Optimization and Modelling of Manufacturing Processes (Casting, Forming, Machining, and Welding), Precision and Micro-Manufacturing Processes, Computer Aided Tool Design.

xvi. Applications of IE & OR in Manufacturing, Logistics, Quality and Maintenance Systems.

xvii. MEMS, Nanotechnology, Miniaturization, Smart structure.

1.11 DEPARTMENT OF METALLURGICAL ENGINEERING AND MATERIALS SCIENCE: MM

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i) B.Tech./M.Tech. in Ceramic, Chemical, Electrical, Electronics, Electrochemical, Mechanical / Production / Manufacturing, Metallurgical, Materials Engineering, Engineering Physics, or

ii) M.Sc. degree in Chemistry, Materials Science, Physics are eligible for admission. For those with M.Sc. degree, mathematics as a subject at B.Sc. degree level is an essential requirement.

The candidates are eligible for research areas consistent with their academic background and special interests.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

Faculty in the Metallurgical Engineering and Materials Science Dept. carry out research on a range of materials:

i. Metals :
Process analysis, instrumentation and control, Iron and Steel making, deformation behavior and microstructure evolution during creep and superplasticity, mineral processing and extractive metallurgy, metal forming, mechanical behavior, welding, physical metallurgy, phase transformation, structure property relationship, thermomechanical processing and texture analysis.

ii. Ceramics :
Electronic ceramics, bio-ceramics, glass ceramics, ceramic foams, industrial ceramics, IR transmitting glasses, near net shape forming, gel casting, rheology of suspensions.

iii. Semiconductors and magnetic materials :
Devices of thin film elemental semiconductors and alloy systems, surface treatment and surface engineering, chemical vapor deposition,

structure property correlation in nano-crystalline magnetic materials, magneto-resistor materials.

In addition, research into materials for sensors and batteries, superconductors, synthesis and processing of ion conductors, materials for energy generation and storage is going on in the Dept.

iv. Polymers and Composites :
Polymer blends, Polymer-carbon nanotube composites, metal-matrix composites, structure property relations.

v. Wear and Corrosion :
Fracture and failure, non-destructive evaluation, aqueous corrosion, metallurgy of corrosion, oil and gas corrosion, and protective coatings (paints, high temperature coatings etc.).

vi. Modeling and Simulations :
Modeling of metallurgical processes, heat and mass transport, modeling of metal forming, Optimization, Monte Carlo simulations, Dislocation dynamics simulations.

FACILITIES AVAILABLE

Various facilities are available for research in the department:

Basic XRD with X- celerator and thin film attachment
1600 Degree Horizontal Single Sample Dilatometer with Accessories
Image Intensifier System and Ex-Ray Source
High Temp. Attachment and Texture and Stress Attachment Unit
Air Vacuum Induction Melting System
Hitachi Scanning Electron Microscope
Simultaneous Thermal Analysis System
R/S SST Plus with Coaxial Cylinder Rheometer
Atomic Absorption Unit AVANTAP
Carbon Sulphur Analyser
High Temp. Furnaces 1700 Deg.C.
UV Visible Spectrophotometer
Thin film processing units
MTS machines
Vibrating sample magnetometer
National facility on OIM and stress determination by XRD

1.11(a) **CORROSION SCIENCE & ENGINEERING: CO**
(under Metallurgical Engineering & Materials Science Department)

Corrosion in Industry has traditionally been looked upon as stumbling block for regular productivity which people normally try to tackle based on previous “experience”. With rapid industrialization the corrosion problems have become more severe and complex warranting investigation by

experts. It is estimated that in India the loss due to corrosion alone is of the order of Rs.10,000 crores per annum. A person trained in any of the standard disciplines cannot tackle these problems effectively because of the complex nature of the corrosion problems. The loss due to corrosion can be reduced to a large extent with the help of properly trained personnel. The present programme is intended to fill this gap. In this course, the students would be trained so that they would be a good asset to any organization where such problems are a matter of concern. Being a hive of chemical industries, a source of crude oil and proximity to the sea, these problems are quite prevalent in and around Mumbai. For this reason, IIT Bombay has taken the lead to offer this specialization course.

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. B.Tech. / M.Tech. in Corrosion Science and Engineering / Metallurgical Engineering / Materials Science Engineering / Electrochemical Engineering / Chemical Engineering / Aerospace Engineering / Electrical Engineering / Mechanical Engineering / Civil Engineering. or
ii. Master's Degree in Chemistry or Materials Science.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

All forms of corrosion including stress corrosion cracking, corrosion fatigue and microbial corrosion.

Corrosion behavior of alloys, ferrous & nonferrous, ceramics, intermetallics and biomaterials, corrosion in concrete, corrosion of weldments, Oil and gas corrosion.

High temperature corrosion and hot corrosion and corrosion at high temperature & high pressure in aqueous media.

Corrosion Protection: Inhibitors, Cathodic Protection, Coating (Conversion coating, anodizing, electroplating, electrophoretic coatings, Organic polymeric coating, plasma sprayed metallic ceramic and functionally graded coatings, high temperature coatings) and surface modification through laser and ion implantation.

1.12 DEPARTMENT OF PHYSICS: PH

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. M.Sc. or equivalent degree in Physics / Chemistry / Mathematics. or
ii. B.Tech. or equivalent degree in Aerospace Engineering / Chemical Engineering / Civil Engineering / Electrical Engineering / Mechanical Engineering / Metallurgical Engineering / Computer Science / Engineering Physics.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. Condensed Matter (Theory) :
Electron correlation in one and many component quntum fluids, many body effects in inhomogeneous electron systems and metal surfaces. Theoretical studies of magnetic systems and super conductivity, Electronic structures of ordered and disordered alloys, insulators, conjugated polymers, cluster, strongly correlated systems, and novel magnetic systems, development of wave-function based ab-initio methods for electronic structure calculations. Biophysics, complex fluids polymers, Stochastic processes, Non-equilibrium dynamics, Slow glassy dynamics, Granular inelastic gases.

ii. High Energy Physics :
Properties and interaction of elementary particles, Gauge field theories and applications to cosmology, Neutrino physics and CP violation, String theory, Collider physics and QCD spin physics.

iii. Condensed Matter Physics (Experimental) :
Magnetic oxide thin films and metallic multilayers for various applications, Mossbaur (transmission and CEMS) spectroscopy of magnetically ordered systems, Amorphous magnetic materials, Permanent magnet materials, Strongly correlate electron systems, Metal-insulator transition, quasi-1d/2d magnetic systems and doping effects, High Tc superconductivity, Josephson tunneling in superconductors. Dilute magnetic semiconductors, semiconductor nanostructures and spintronics materials. Electrical and optical properties of semiconducting oxide and nitride (GaN, SiC, ZnO) thin films, nanoparticles and nanostructured thin films, Langmiur Blodgett organic multilayers, conducting polymers, Chemical Vapour Deposition (CVD) process; Polycrystalline and single crystal diamond films, Carbon nanotubes (SWNT and MWNTs); their structural and electrical properties.

iv. Nuclear Physics (Experimental) :
Nuclei at high angular momentum Hadron Physics, Physics beyond standard model and relativistic Heavy ion Physics.

v. Laser, Optics & Spectroscopy (Experimental) :
Laser spectroscopy, Coherent optics, Fiber optics, Nonlinear optics, Ultra-fast phenomena and laser physics.

2. INTERDISCIPLINARY GROUPS

2.1 ENERGY SYSTEMS ENGINEERING: EN

Energy is a critical input required for development. Fossil fuel reserves in the country are limited and there is a need to develop viable cost effective alternatives. Renewable and Nuclear Energy can provide possible long-term solutions for the energy problems. There are problems in the large-scale development and deployment of these alternatives that need to be addressed. In the short run India has to aggressively pursue energy efficiency and Demand Side Management to Improve the efficiency of supply and utilization devices and systems. The development of new energy technologies provides a technological challenges as well as significant business opportunity. In order to help meet these challenges, the Energy Systems Engineering (ESE) interdisciplinary programme has been established with a mission to develop sustainable energy systems and solutions for the future. There is a requirement for high quality trained manpower in the energy sector. This also provides scope for engineering innovators/ entrepreneurs. The ESE programme has two laboratories (Solar Energy and Energy Systems Laboratory) and a computational facility. In addition to this, ESE students are actively involved in the research and development activities of the Thermal Hydraulics facility, Gasification Laboratory, Heat Pump Laboratory (Mechanical Engineering), Power Electronics and Power Systems Laboratory (Electrical Engineering). ESE faculty have been organizing several Continuing Education Programme on a continuous basis on Renewable Energy, Energy Management, Process Integration, Solar Passive Architecture and have initiated a series of programmes for the Nuclear Power Corporation. ESE has established linkages with industries like Thermax, Forbes Marshall, BSES, Mahindra & Mahindra, BHEL and organization like Atomic Energy Regulatory Board, Ministry of Non-Conventional Energy Source, International Energy Initiative and The Energy and Resource Institute which have sponsored M.Tech/Ph.D Projects. This has ensured the relevance of the ESE research output.

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. B.Tech. / M.Tech. Degree in any of the following branches of engineering: Aeronautical / Aerospace, Chemical, Civil, Electrical, Energy, Mechanical, Metallurgical. or
ii. M.Sc. in Chemistry / Physics / Mathematics with a good academic record and a minimum of two years of relevant engineering experience in an energy related field.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

i. Energy Efficiency / Improvements in conventional Energy Systems :

Heat pumps, Energy integration, Process integration for resource optimization, Pinch Analysis Development of techniques for optimization of Utility systems, Demand Side Management / Load Management in the Power Sector, Variable Speed Drives, Power Generation and Systems Planning, Energy Management and Auditing, Efficient Motor Drive Systems, Electronics Ballasts, Static VAR compensators, Illumination control, Power Electronics in Energy Efficient Systems, Electric Vehicles, Boilers and Fludised Bed Combustion, Exhaust Heat Recovery, Cogeneration, Building Energy Management, Efficient Air Conditioning Systems, Hydrogen Generation and Storage, Fuel Cells.

ii. Renewables :

Biomass Gasifier Design, Development and Testing, Pyrolysis for liquid fuels and chemical, CNG Kit development, Industrial Solar Thermal concentrators, Stirling Engine Systems, Testing of Solar Collectors and systems, Passive Solar Architecture, Development of Carbon PV cell, Decentralized Power Systems Grid Integration Issues, Hybrid Systems for Rural Electrification, Wind Energy, Low Cost Solar Drier, Fuel Cells, Thin film solar cells, Carbon nano tubes for hydrogen storage, Solar photovoltaic concentrator, Development of Engines for SVO, Biodiesel, Dual fuelling etc., Biodiesel manufacturing process.

iii. Nuclear :

Nuclear Safety, Nuclear Waste management, Thermal Hydraulics Research, Computer Simulation Models for Analysis of Transients in Pressurized Heavy Water Reactor.

iv. Fellowships

Several fellowship are normally available to ESE students ranging from Rs.10,000/- per month. In addition to Institute assistantship, fellowships are also available to ESE students from Ministry of New

Renewable Energy (MNRE) (2 fellowships of more than Rs.10,000/- per month).

2.2 INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH: IO

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. Master's degree in any branch of Engineering with adequate exposure to Industrial Engineering and Operations Research or
ii. M.Sc. in Mathematics, Statistics or Operations Research with an excellent academic record. or
iii. Bachelor's degree in any branch of Engineering with an excellent academic record.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

The group is interested in research related to modeling, quantitative analysis and optimal resource allocation from decision problems in deterministic and stochastic contexts. Broad areas of application are in manufacturing systems, supply chains, logistics, transport including railways, finance, services, infrastructures and other industrial systems; application of quantitative methods in quality and maintenance management systems; development and application of decision support, intelligent and knowledge based systems.

The specific problems of interest include: production planning, scheduling and control systems; management of inventories in production, distribution and service systems; industrial scheduling, facilities planning, project management, quality management, material management and productivity management; operation, planning and control related to CMS, MRP, flexible assembly, FMS, JIT, Supply Chains and ERP; reverse logistics and RFID applications, product variety management.

Operations Research applications in management of technology and resource allocation; optimal control in stochastic systems; applications of game theory, modeling and simulation of supply chains, manufacturing and service systems; theory and applications of distributed simulation, discrete event and system dynamics simulations; applied stochastic models; scheduling and control of railways and other transport operations; time tabling of services, crew and vehicle scheduling for transport operations; optimization and design problems arising from e-commerce, including auctions and mechanism design for electronic exchanges; risk analysis and contract design; revenue management; quantitative models

for financial engineering. Theory and applications of neural nets and fuzzy systems in manufacturing and management; development and applications of modern information systems for managing manufacturing, supply chain and service organizations.

The IEOR programme is unique in its contemporary flavour, with new courses in Financial Engineering, Services Management, Knowledge Based Systems, Neural Networks, Supply Chain Management, Engineering Economy, Manufacturing systems to name a few. The programme is equally strong in background building, with updated courses in Optimization Techniques, Stochastic Models and Simulation.

2.3 RELIABILITY ENGINEERING: RE

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
B.E. / B.Tech. / M.Tech. in Aerospace / Chemical / Civil / Electrical / Mechanical / Metallurgical/ Computer Sciences / Electronics / Instrumentation & Control/Reliability Engineering.

Candidates with bachelors degree in engineering must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

Reliability of Microelectronics Devices and Systems, Mathematical Modeling and analysis of systems reliability, Maintenance Management, Quality Planning and analysis, Power Systems Reliability, Reliability based Civil Engineering Design, Six sigma & Innovation, Software Reliability (testing and quality assurance).

2.4 SYSTEMS AND CONTROL ENGINEERING: SC

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
M. E. / M.Tech in Aerospace / Chemical / Electrical / Electronics / Instrumentation / Mechanical / Metallurgical Engineering / Systems and Control Engg.

RESEARCH AREAS

Modeling and simulation of various types of dynamic systems, Linear and Non-linear controls, Variable structure systems and sliding mode control, Control of large size nuclear reactor, System identification, Adaptive and learning systems, Robust and optimal control, Statistical dynamic of

system, Aircraft control systems, Process control systems, Robotics control systems, Fuzzy logic systems and Neural network based control systems, Reliable computing, Quantitative feedback theory, Geometric mechanics and control, Underactuated systems.

3. CENTRES

3.1. CENTRE FOR ENVIRONMENTAL SCIENCE AND ENGINEERING : EV (CESE)

ELIGIBILITY FOR ADMISSION

In view of the interdisciplinary nature of the Environmental Science and Engineering subject, students from diverse areas of sciences, engineering and medical sciences are permitted to apply for Ph.D. However, students who do not have adequate background knowledge will have to take additional courses to enable them to successfully pursue research in Environmental Science and Engineering.

First Class or 60% marks (55% for SC / ST) in :

i. Bachelor or Master of Engineering degree in Aeronautical / Aerospace, Agricultural, Atmospheric Science, Chemical, Civil, Energy Systems, Environmental, Mechanical, Metallurgical, Mining. or
ii. Master of Science degree (Mathematics at the Higher Secondary Intermediate Level) in Atmospheric Sciences, Biochemistry, Biotechnology, Chemistry, Earth Sciences, Environmental Toxicology, Environmental Science, Life Sciences, Medical Sciences, Meteorology, Microbiology, Physics, Public Health & Statistics are eligible for Ph.D. admission.

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

RESEARCH AREAS

The research and developmental activities of the CESE encompass a wide spectrum of areas in Environmental Science and Engineering such as environmental monitoring, industrial air and water pollution control, solid and hazardous waste management, air and water quality modeling, environmental systems optimization, environmental microbiology and biotechnology, bioremediation, indoor air quality, aerosol science and technology, environmental impact assessment and global issues. For further details, visit www.cese.iitb.ac.in

3.2 INDUSTRIAL DESIGN CENTRE (DESIGN): IDC

Over the past few years, the need of research and knowledge generation in design has been growing which resulted in starting the Ph.D. program in Design at IDC. Apart from the core areas of design, designers are expected to work in many interdisciplinary areas such as management, information technology, engineering, sociology, psychology, media, education, etc. throwing up new challenges.

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC/ST) in :

i. M.Des. / M.Arch. / M.Tech. / M.Phil. / MFA / Post-Graduate Diploma in Design of NID, Ahmedabad and equivalent or
ii. B.Des. / B.Arch. / BFA / MA / M.Sc. / Under-Graduate Diploma in Design of NID, Ahmedabad or equivalent degree with exceptionally outstanding design related work with a valid CEED score.

Candidates with a minimum of three years of relevant professional experience without CEED scores can also be considered. However, such candidates will not be awarded Teaching / Research Assistantship.

RESEARCH AREAS

The faculty at IDC besides working on application and project oriented research, also works in depth on various topics mentioned below:

i. Product aesthetics
ii. Creativity and Innovation
iii. Design Management
iv. Design and Culture
v. Design theory
vi. New product design & development
vii. New media design
viii. Design thinking and methods
ix. Learning environments
x. Product ergonomics
xi. Animation
xii. Print Media

3.3 CENTRE OF STUDIES IN RESOURCES ENGINEERING: CSRE

ELIGIBILITY FOR ADMISSION

The domain of “Natural Resources Engineering” is highly interdisciplinary encompassing issues as diverse as socio economic policies of sustainable development, environmental impacts of natural resources exploitation,

technological aspects of modern tools and techniques of Satellite Remote Sensing, GIS, GPS, RADAR and LIDAR etc. The issues of global warming, climate change, renewable energy resources etc. are assuming global importance and can be directly related to several aspects of natural resources exploration, exploitation, and management. The researchers in these areas can come from diverse background of science and engineering. Students who do not have adequate background will be required to take additional courses as may be necessary to enable them to undertake research in the chosen aspects of natural resources.

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC/ST) in :

i. B. Tech. in any branch of engineering or
ii. M.Sc. in any branch of science with Mathematics as a subject upto 10+2 level. or
iii. M.Tech. in any branch of engineering

Candidates with bachelors degree in engineering or masters degree in science must have a valid GATE score to become eligible for the Teaching / Research Assistantship provided by the Institute.

The applicant should have a relevant background to carryout reseach in the field of Natural Resources Engineering. For more details please visit (www.csre.iitb.ac.in)

RESEARCH AREAS

a) Remote Sensing and GIS applications in
   i. Water Resources
   ii. Terrain Evaluation, Land-use planning and monitoring
   iii. Rural Development and Agro-informatics
   iv. Mineral exploration and earth sciences
   v. Natural hazards of drought, desertification, landslide, avalanche, earthquake, tsunami etc.
   vi. Marine resources and ecology.

b) Digital Image Processing
c) Computer Vision and Graphics
d) GIS data processing and analysis
e) Microwave Remote sensing
f) Digital Photogrammetry and Cartography

4. SCHOOLS

4.1 SHAILESH J. MEHTA SCHOOL OF MANAGEMENT: MG

ELIGIBILITY FOR ADMISSION

i. B.E. / B.Tech. or equivalent with first class (55% for SC / ST) with minimum of 2 years of relevant work experience. or
ii. M.E. / M.Tech. or equivalent degree with first class (55% for SC / ST) at graduation and post graduation level. or
iii. Master of Management / M.B.A. or equivalent with first class (55% for SC / ST) at graduation and post graduation level. or
iv. M.Sc. / M.A. / M.Com. / LLM / MCA or equivalent with first class (55% for SC / ST) at graduation and post graduation levels and 2 years of relevant work experience.

The above is eligibility criteria for admission to Ph.D. programme in Shailesh J. Mehta School of Management, however, entitlement for award of Teaching Assistantship as mentioned against 9.1 of this brochure will be applicable.

RESEARCH AREAS

i. Technology Management
ii. Operation Management
iii. Project Management
iv. Economics
v. Quantitative Method
vi. General Management
vii. Management of Information Technology
viii. Financial Management
ix. Marketing Management
x. Organization Behavior
xi. Human Resource Management
xii. International Business
xiii. Management of Intellectual Property Rights
xiv. Entrepreneurship

FINANCIAL SUPPORT

In addition to the Institute Teaching Assistantships, the School has Shailesh J. Mehta Endowment which provides fellowships. Students admitted to full-time Ph.D. Programme at the School are eligible to apply for National Doctoral Fellowship (NDF) awarded by All India Council for Technical Education (AICTE).

4.2 SCHOOL OF BIOSCIENCES AND BIOENGINEERING: SBB

PREAMBLE

The School of Biosciences and Bioengineering comprises of BT (Biotechnology) and BME (Biomedical Engineering) as core academic groups. It has CB (Chemical Biology) and BC (Biochemical Engineering) as associated academic groups. In addition, faculty members of other departments are also associated with the School of Bioscience and Bioengineering. Students admitted to the program have backgrounds in Engineering, Physical Sciences, Life Sciences and Medicine. Eligibility criteria and research areas of the above groups are mentioned below. Students should mention in item No.10(b) of Application Form in the order of priority any TWO groups (BT, BME, CB or BC) they wish to join. Based on the respective eligibility criteria and academic performance, applications will be screened independently by the above groups for conducting interview, according to the priority mentioned by the candidate in the application form.

4.2.1 **BIOTECHNOLOGY:** **BT**

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i) M.Sc. or equivalent degree in subjects related to Biological and Life Sciences / Physics / Chemistry with valid GATE / CSIR / UGC / DBT / ICMR / Research Fellowship (Not Lectureship) or 2 year research experience. or

ii) B.Tech / B.Pharm or equivalent degree with valid GATE / CSIR / UGC / DBT / ICMR / Research Fellowship (Not Lectureship) or 2 year research experience. or

iii) M.Sc./MBBS degree in occupational Physiotherapy, with AIIMS (PG Entrance Test) / MCI entrance examination for MD / MS (for Medical graduate) / MBBS with MD / MS. or

iv) M.V.Sc. / M.Pharm / M.Tech or equivalent degree.

RESEARCH AREAS

Enzyme kinetics and enzyme secretion, microbial metabolism and regulation, aromatic hydrocarbon metabolism and genetic engineering, enzyme inhibitor design, peptide synthesis; protein structure, function and engineering; yeast molecular biology, transcriptional regulation of gene expression; microtubule dynamics and cancer chemotherapy; immunology, signal transdution, Glycobiology; molecular and membrane biochemistry.

4.2.2 **BIOMEDICAL ENGINEERING:** **BME**

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :

i. M.Tech / M.E. in Biomedical, Chemical, Computer Science, Electrical, Electronics, Instrumentation, Mechanical Engineering, Metallurgy and Materials Science, Telecommunications Engineering, Engineering Physics or equivalent degree. or
ii. B.Tech / B.E. in above mentioned area or equivalent with valid GATE scores. or
iii. M.Sc. or equivalent in Biochemistry, Biophysics, Biotechnology, ceramics, Chemistry, Electronics. Ergonomics, Material Science, Mathematics, Molecular Biology, Physics and Physiology with valid GATE / CSIR / UGC / DBT / ICMR (Not Lectureship) fellowships or 2 years research experience. or
iv. MBBS degree or graduate degree in occupational Psychotherapy or BDS with AIIMS / All India MCI / JIMPER / PGI Chandigarh / AFMC Pune / DNB Part I national level postgraduate entrance examinations or GATE Life Sciences scores or CSIR / UGC / DBT / ICMR (Not Lectureship) fellowships. or
v. M.Pharm / MD / MS / MDS / MVSc or equivalent degree.

RESEARCH AREAS

Bioinstrumentation for diagnostics and therapeutics, Biomaterials, tissue engineering prostheses and medical devices, bionanotechnology, controlled drug delivery systems, neurophysiology, physiological modeling and analysis, biosensors, signal processing, telemedicine.

4.2.3 CHEMICAL BIOLOGY: CB

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
M.Sc. or equivalent degree in Chemistry / Biochemistry / Biotechnology / Biological Science / Life Science / Materials Science / Pharmacy / Physics with valid GATE score or a valid award of a CSIR / UGC / DBT / ICMR Research Fellowship.

Holders of NET Lecturership can be considered for admission, if they have minimum of two years of professional experience from a reputed organization, **however, they will not be considered for Teaching Assistantship / Research Assistantship.**

RESEARCH AREAS

Chemical biology deals with topics which lie at the interface between biology and chemistry. It concerns chemists as well as biologists who seek to understand biological systems at the molecular level. The current research interest of Chemical Biology group at IIT Bombay includes the following topics – Peptides and proteins, de novo protein

design, synthetic methods towards unusual amino acids, peptide modifications, molecular biophysics, protein folding mechanisms, molecular enzymology, enzymatic photocatalysts, photoreceptor proteins, semisynthetic protein photoreceptors for nanotechnological applications, biomolecular caging of proteins and other bioactive compounds, fluorescence probes, thermodynamics of biomolecular interactions, bidegradable and conducting polymers, biosensors for ions and molecules, metal complexs with biological impact, biomimetic chemistry in metallocalixarenes, organized assemblies.

4.2.4 BIOCHEMICAL ENGINEERING: BC

ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% for SC / ST) in :
B.Tech / BE / Equivalent or M.Tech / ME / Equivalent in Chemical Engineering, Biotechnology, Biochemical Engineering, Biomedical Engineering or
M.Sc. or equivalent in Biological and life sciences, physics, chemistry, biophysics, mathematics, Computer applications, Bioinformatics with valid GATE score or a valid award of a CSIR/UGC/DBT/ICMR Research Fellowship.

Holders of NET Lecturership can be considered for admission. Candidate with minimum of two years of professional experience from a reputed organization, **however they will not be considered for Teaching Assistantship / Research Assistantship.**

RESEARCH AREAS

Bioreaction Engineering: Microbial and enzymatic kinetics, Unstructured and structured models, Modeling and analysis of Metabolic Regulation; Metabolic Engineering: Metabolic Flux Analysis, Media Optimization, Recombinant technology, Cellular optimization; Genetic Engineering: Foreign protein synthesis, reactor level optimization; Bioprocess Optimization and Control: Fed-batch operation; Bioseparations: Affinity separations; Bioinformatics: Protein structure evaluation, analysis of genetic networks and micrroarray data, computational and systems Biology; Environmental Biotechnology.

APPLICATION PROCEDURE

Cost of application is Rs.300/- for General/OBC and PC (Physically Challenged) candidates & Rs.150/- for SC/ST candidates to be paid by the Demand Draft drawn in favour of "**Registrar, IIT Bombay**".

You are provided with the following:

i. Information Brochure.
ii. Application Form.
iii. Statement of Purpose form.
iv. Forms for recommendations. (Two)

After carefully reading the instructions given in the brochure, fill in the application form in all respect. You may apply for as many disciplines as you wish. **However you can write maximum three disciplines in one form (including interdisciplinary areas) and for rest applicant can use another form by paying separately.**
Please fill in the application form completely and then take as many xerox copies of the application form as per the number of disciplines applied for.

Statement of Purpose

Statement of Purpose (SoP) is your opportunity to share with the Admission Committee your motivation and preparation for the Doctoral studies at IIT Bombay.

Please fill in the format provided to you along with application form and attach the same.

The application form (in 27 cm x 12 cm size envelope without folding, along with the xerox copies, and Statement of Purpose should be posted by using the brown envelope. Please mail this envelope to **Deputy Registrar (Academic), IIT Bombay, Powai, Mumbai - 400 076.** The Application Form must reach on or before 04.05.2007.

Recommendation Letters

Two recommendations from people who know your Academic & Professional performance and Achievements. The person giving recommendation may be from your College / University or from Organization where you have worked.

Please handover these (format for recommendation & labeled envelope) to the recommenders. The recommendation will be sent by recommender directly to the Institute.

Candidate can submit as many forms as he / she wishes.

Candidates should complete the application form in all respects. Incomplete application forms will be rejected.

Form should be filled in neatly and clearly.

SC / ST / OBC / PC candidates are requested to attach Caste / Tribe / Disability certificate along with application form.

(C) APPENDIX

Appendix I

Sponsorship Letter for full-time candidates

(This should be typed on letterhead of the sponsoring organization)

To
The Director,
Indian Institute of Technology, Bombay
Mumbai – 400 076.

Sub: Sponsoring of an Employee for Ph.D. programme

Dear Sir,

We hereby sponsor the candidature of _____ who is an employee in our organization, for joining Ph.D. programme in _____ at your Institute as a FULL-TIME candidate.

We shall bear the total expenses of his/her studies. We shall fully relieve him/her of his/her duties in the organization during the entire period of the Ph.D. programme to enable him/her to devote full time to the studies.

Signature and seal of the
Sponsoring Authority

Appendix II

Employer's Letter in case of Candidates joining on Study Leave

(This should be typed on a letter head of the Institution)

To
The Director,
Indian Institute of Technology, Bombay
Mumbai – 400 076.

Sub: Relieving an employee on Study Leave

Dear Sir,

We hereby relieve Shri / Smt. / Kum. _____ an employee of this Institute on full / half / no pay leave for joining Ph.D. programme at IIT Bombay, for a period of _____ years. (at least three years)

Signature of Head of the

Institute and seal of the Institution

Appendix III

Sponsorship Certificate for External Registration

(This should be typed on a letter head of the Sponsoring Organization)

1. Name of the sponsoring organization : _____
2. Address :_____
3. Present Designation of the applicant :_____
4. Present status of the applicant: _____
   (Permanent/Quasi Permanent/Temporary)
5. Division where research work is proposed to be done: _____
6. Name of supervisor from the sponsoring organization: _____
   (Bio-data of supervisor to be enclosed giving details of designation, qualification, research experience etc.)
7. Details of facilities relevant to the research problem which will be made available to the candidate by the organization.
8. Statement of External Supervisor.

If Shri / Kum. / Smt._____ is registered for the doctorate degree I agree to act as his/ her research supervisor jointly with the research supervisor form the Institute.

Signature of External Supervisor

If Shri / Kum. / Smt. _____ is admitted to the Ph.D. programme, we shall allow him/ her to undergo the programme of studies and also to fulfill the residential requirement of the Institute, as per rules.

During the period of Doctoral programme the candidate will be permitted to carry out his / her research work at our laboratories / organization and will be given the required facilities.

We also give our consent to _____ of our organization to supervise the Ph.D. Project, jointly with Dr. / Prof._____ of IIT Bombay.

Signature and Seal of the
Sponsoring Authority

Appendix IV

No Objection Certificate from University for College Teacher Category.

(This should be typed on a letterhead of the Institution/University)

Dear Sir,

This is to certify that the University has no objection to sponsor the candidature of Shir / Ms _____, who is working as _____ in the _____ College, to join the Ph.D. Programme at IIT Bombay, under College Teacher Category.

Signature & Seal of the Head
of the University/ Institution.

[Bio-data of External Supervisor (which is optional) to be enclosed giving details of designation, qualification, research experience, etc]

Appendix V
Fees and Deposits:

Fees, Deposits & Hostel Rent

GENERAL

Particulars	Students staying in Hostels	Students not staying in Hostels
At the time of admission*	**Rs.**	**Rs.**
Admission Fee	150	150
Provisional Certificate	100	100
Medical Examination	100	100
Students Welfare Fund	200	200
Modernisation	500	500
Thesis Fee	950	950
Identity Card	25	25
Course of Study Bulletin	100	100
Institute Day Fee	50	50
Valedictory Function Fee	50	50
Total (I)	**2225**	**2225**
DEPOSITS:		
Institute Security Deposits	1000	1000
Library Security Deposits	1000	1000
Mess Security Deposits	1000	-
Total (II)	**3000**	**2000**
ANNUAL CHARGES*		
Annual Insurance Premium	126	126
Total (III)	**126**	**126**
PER SEMESTER**		
Gymkhana	100	100
Examination Fee	300	300
Registration Fee	300	300
Tuition Fee	2500	2500
Medical Fee	50	50

Particulars	Students staying in Hostels	Students not staying in Hostels
Hostel Rent	550	-
Hostel Establishment Charges	300	-
Contribution to hostel subsidy**	1750	-
Fan, Elect., Water Charges	300	-
Student Benevolent Fund	100	100
Medical Fund	50	50
Hostel Maintenance Fee	500	-
Total (IV)	**6800**	**3400**
Grand Total (I + II + III + IV)	**12,151**	**7,751**

* **Fees (except Deposits) are not refundable under any circumstances.**
** LIKELY TO BE REVISED

In addition to the above, refundable Mess advance of Rs. 2,000/- and Semester Mess Advance of Rs. 7,000/- is to be paid by the candidate opted for staying in hostel.

Fees payable in every subsequent semester by External Candidate: Rs.2,500/- for General Category and Rs.900/- for Reserved Category (SC/ST).

Candidates from reserved categories (SC/ST) are fully exempted from paying the Tuition Fees.

Students who are staying in Quarters such as Tansa, Tulsi and QIP Quarters, are required to pay license fees, water & Elect. Charges, Furniture rent etc. as applicable for occupied quarters, as per the rules of the Estate Office, IIT Bombay.

To utilize and maintain any motorized vehicle on the campus is prohibited.

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