INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

IIT BOMBAY AND TOHOKU UNIVERSITY JAPAN (IITB-TU) Double Doctoral Degree PROGRAM (DDDP)

ADMISSION 2026-27

- New Programme from the AY.2026-27

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I. Important Guidelines for DDDP Programme Application

1 Please read the instructions given in the brochure carefully before filling up the application form.

2 **Online** Application Form & Information Brochure (including the admission schedule along with the important dates) is available on the Institute website at the link, https://acad.iitb.ac.in/admissions/researchYou are required to submit the application **ONLINE**. No Downloadable Forms will be available. After filling the form, you are advised to take a print of your application and keep the same for the record.

3 The application fee is as follows,

Category	Application fee for Regular Period **Without Fine** (In Rs.)	Application fee for Extended period **With Fine** (In Rs.)
Women candidates	150/-	650/-
SC/ST/PwD category candidates	150/-	650/-
All other candidates	300/-	800/-

The fee is to be paid by SBI Internet Banking/ Online Payment System and you do not have to submit the printed copy of the application. **Applications without online payment details will not be considered.**

APPLICATION FEE IS NON-REFUNDABLE.

4 You can apply for up to **THREE** disciplines/specialisations.

5 Along with your application, you have to submit a Statement of Purpose or a Research Proposal as required by an academic unit.

6 You should complete the application form in all respects. Incomplete application will not be considered.

7 You **MUST** upload the following while submitting the application.

a) Scanned version of photograph.

b) Scanned version of signature.

c) Mark-sheet of the last semester/ Consolidated mark-sheet of the qualifying degree. Result awaited candidates have to upload their latest/previous semester mark-sheet.

d) Caste Certificate (OBC-NC/SC/ST), if applicable. An affidavit for having applied in case the certificate is not yet received.

e) Economically Weaker Sections(EWS) candidates needs to submit EWS certificate issued by the Competent Authority in the prescribed format.

f) PwD Certificate, if applicable.

g) Sponsorship certificate, if applicable.

h) (please upload Sponsorship Certificate, If not available then attach Self-Declaration letter stating that the sponsorship certificate will be given at the time of Interview/ Admission).

i) Project Staff/ Institute Staff should submit No Objection Certificate (NOC)' a letter of recommendation from the Principal Investigator (PI)/ Head/Office-In-Charge at the time of application.

j) Statement of Purpose (SoP), a sample of writing (if applicable), research proposal (if applicable), as a single file irrespective of the number of disciplines/ specialisations.

8 OBC-NC candidates may note that the limit of annual income is Rs. 8 lakhs for determining the creamy layer among Other Backward Classes (OBCs) candidates.

The OBC-NC certificate issued for the financial year 2026-27 by the Competent Authority in the prescribed format must be uploaded in the ONLINE application form and submitted at the time of admission.

The OBC reservation update Information is available in the public domain https://acad.iitb.ac.in/admissions/research nder OBC Reservation Update.

9 Economically Weaker Sections(EWS) candidates may note that the limit of annual income is Rs. 8 lakhs for determining the eligibility for benefit under Economically Weaker Sections (EWS) reservation.

The EWS certificate issued by the Competent Authority in the prescribed format must be uploaded in the ONLINE application form and submitted at the time of admission.

The EWS reservation update Information is available in the public domain https://acad.iitb.ac.in/admissions/research under EWS Reservation Update.

10 PwD candidates will be given extra time, as per the government of India rules on request by the candidate. Such requests need to be addressed to Head of the concerned academic units through email/hard copy well in advance.

11 Seats are reserved for Economically Weaker Sections(EWS)/ Other Backward Class Non-Creamy Layer (OBC-NCL)/ Scheduled Caste (SC)/ Scheduled Tribe (ST) and Person with Benchmark Disability (PwD) Categories , as per Government of India rules.

12 You should check the Institute website for results / important announcements.

13 You should check emails sent to the email address provided in your application for all important communications and announcements.

14 Merely fulfilling eligibility criteria doesn't entitle a candidate to be called for the test and/or interview. Admission is based on GATE/Written test/Interview performance in addition to general eligibility criterion, the applicants must also satisfy the eligibility criteria specified for the respective Departments/ Centres / Schools / Interdisciplinary Groups.

15 Candidates, if called for written test/interview should show/ bring with them (i) Photo ID Card, (ii) Printed copy of the application submitted online, (iii) Thesis / dissertation / report / publications (iv) copy of certificates and mark-sheets.

16 Candidates having degree from foreign universities should submit equivalence certificate from Association of Indian Universities (AIU), New Delhi for qualifying Exam and proof of having First class or 60% (55% for SC/ST/PwD) marks or equivalent in qualifying examination.

17 Read the Frequently Asked Questions (FAQ) given on Institute website https://acad.iitb.ac.in/admissions/research for more details.

18 Contact Details for - Ph.D. - phd_unit5@iitb.ac.in

19 Students must submit self-attested copies of his/her qualifying degree certificate & final transcripts on or before **31th August, 2026 (admitted in Autumn Semester)/January 29, 2027(admitted in Spring Semester),** failing which admission will stand cancelled.

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II) Tentative Schedule of IIT Bombay – Tohoku University (Japan) Double Doctoral Degree Programme (IITB–TU DDDP) Admission - Application form throughout the year

- as available on the webpage https://acad.iitb.ac.in/admissions/research

(A) Important Dates: {AUTUMN SEMESTER}

B) Important Dates: {SPRING SEMESTER}

Results will be declared on IIT website : https://acad.iitb.ac.in/admissions/research

The dates given are tentative. Any changes in the dates will be indicated on the website.

A) GENERAL

A.1) THE INSTITUTE

The Indian Institute of Technology Bombay (IIT Bombay) is one of the 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. The Institute was established in 1958. It 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 (B.Tech.), Postgraduate (M.Tech.), M.S. By Research and Doctoral (Ph.D.) programmes are offered at IIT Bombay on the Institute website https://acad.iitb.ac.in/admissions/research

The listing of all the Masters' programmes and Ph.D. programmes offered in various academic units are given below,

Programmes	Discipline [Academic Unit : Department, Centre, Interdisciplinary Group]
M.Tech./M.Tech.+ Ph.D. (Dual Degree)	Aerospace Engineering, Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Science & Engineering, Earth Sciences, Electrical Engineering, Energy Systems Engineering, Environmental Science & Engineering, Geoinformatics and Natural Resources Engineering, Industrial Engineering & Operations Research, Mechanical Engineering, Metallurgical Engineering & Materials Science,Materials, Manufacturing and Modeling, Systems and Control Engineering, Technology and Development, Educational Technology, Centre for Climate Studies
M.Des. and M.Des. by Research Programmes	Industrial Design Centre
MBA	Shailesh J. Mehta School of Management
MBA (Executive)	Shailesh J. Mehta School of Management
M.Sc.-Ph.D. (Dual Degree) in Energy	Energy Science and Engineering
MPP	Centre for Policy Studies
Master of Science by Research	Computer Science & Engineering, Data Science and Artificial Intelligence (CMINDS), Healthcare Informatics (KCDH)
MA+Ph.D. (Dual Degree) in Philosophy	Humanities & Social Sciences

Master of Arts by Research (MA.Res.)	Humanities & Social Sciences
Master in Development Practice (MDP)	Centre for Technology Alternatives for Rural Areas
Ph.D	Aerospace Engineering,Biosciences and Bioengineering, Chemical Engineering, Chemistry, Civil Engineering, Climate Studies, Computer Science and Engineering, Industrial Design Centre, Earth Sciences, Educational Technology, Electrical Engineering, Energy Science & Engineering, Environmental Science and Engineering, Economics,Geoinformatics and Natural Resources Engineering Humanities and Social Sciences, Industrial Engineering & Operations Research, Management, Mathematics, Mechanical Engineering, Metallurgical Engineering and Materials Science, Collaborative Research on Science and Technology - (erstwhile CRNTS). Physic, Policy Studies, Systems & Control Engineering, Technology and Development, Urban Science & Engineering, Digital Health, Machine Intelligence and Data Science,Desai Sethi School of Entrepreneurship, **C**enter for Defence Technology Innovations and Strategies, Centre for Traditional Indian Knowledge and Skills, Medical Technology Research and Innovation Centre. Motilal Oswal Centre for Capital Markets, Centre for Semiconductor Technologies (SemiX)]
IIT Bombay – Tohoku University (Japan) Double Doctoral Degree Programme (IITB–TU DDDP **- New Programme from AY 2026-27**	Artificial Intelligence & Machine Learning, Digital Health, Disaster Mitigation, Energy & Sustainability, Materials Science, Quantum Computing, Robotics, Semiconductors, Thermals & Fluids, and Transportation.

The Institute on an average admits 1751 candidates for the Undergraduate programmes and 2007 candidates for different Postgraduate and Doctoral programmes every year. Students from Bangladesh, Egypt, Ethiopia, Fiji, Iran, Iraq, Pakistan, Jordan, Mauritius, Malaysia, Nepal, Palestine, Sri Lanka, Vietnam and Yemen are also undergoing training in various programmes. In addition to these academic programmes, the Dean (Educational Outreach) 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, teachers from various engineering colleges also join Institute for the postgraduate and doctoral programmes. under Dean (Educational Outreach).

A.2) RESEARCH FACILITIES

All the academic units 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 and Central Workshop. The Central Library has a very large collection of books, back volumes of periodicals, standards specifications and other literature in print and electronic format.The Library now holds more than 5 lakh books and bound volumes, 20,000 e-books, and subscriptions to more than 20,000 current journals in the domains of science, engineering, humanities and social sciences, management, and associated fields. More than 30 databases, including Bloomberg terminal, financial, bibliographical, and citation databases, are also subscribed by the Central Library. Additionally, the Central Library offers users access to use research-supporting technologies like grammarly, overleaf, Turnitin, Drillbit plagiarism detection tools, and provides access to millions of electronic theses.

The Institute has many research collaborations with leading universities in USA, Europe, Japan, and other East Asian 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.

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 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.

A.3) STUDENTS AMENITIES

The Institute is fully residential and has 18 hostels for students. Each hostel is an independent entity with its own mess facilities, recreation areas, etc. Some flatlets are available for married research scholars.

Extra-curricular activities are provided by the Students' Gymkhana. These activities include Sports, Cultural programmes and Social Service. 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 (SAC) routinely organizes several vibrant extra curricular events.

A.4) DDD PROGRAMME

With extensive infrastructural facilities and a sound research base, the Institute offers Ph.D. programme in a wide range of areas in Engineering, Sciences and Humanities & Social Sciences. The broad objectives of the Ph.D. programme are to contribute to expanding the frontiers of knowledge and to provide research training.

The academic programme leading to the Ph.D. degree is broad-based and involves a course credit requirement and a research project leading to thesis submission. The Institute also encourages research in interdisciplinary areas through a system of joint supervision and interdepartmental group activities. 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 Engineering, Biosciences and Bioengineering, Chemical Engineering, Chemistry, Civil Engineering, Computer Science and Engineering, Earth Sciences, Electrical Engineering, Energy Science & Engineering, Humanities and Social Sciences, Mathematics, Mechanical Engineering, Metallurgical Engineering and Materials Science, Physics, Industrial Design Centre, Environmental Science and Engineering Department, Economics, Centre of Studies in Resources Engineering, Centre for Research in Nanotechnology & Science and Centre for Technology Alternatives for Rural Areas , Centre for Urban Science and Engineering, Interdisciplinary Groups in Climate Studies, Educational Technology, Industrial Engineering & Operations Research and Systems & Control Engineering and in Shailesh J. Mehta School of Management, Desai Sethi School of Entrepreneurship.

A.5) ELIGIBILITY CRITERION FOR ADMISSION

A.5.1) General eligibility criterion for Admission in all academic units : Departments, Centres, Schools and Interdisciplinary Groups:

Qualifying Degree:

1a. Master's or equivalent degree in Engineering/Technology

1b. M.B.A (with B.Tech./ B.E. or equivalent degree)

2a. Bachelor's degree in Engineering/ Technology/ Medicine (4 year degree)

2b. Bachelor degree in Science (BS) (4 year degree)

3. Master's or equivalent degree in science

4. Master's or equivalent degree in Arts/ Commerce (or allied subjects)

For qualifying degree listed under (2), (3) & (4), candidates must also fulfil ONE of the following additional requirements:

a) a valid GATE score or JEST score (for Physics dept. and Department of Biosciences and Bioengineering only).

b) Selected through National Eligibility Test – UGC NET including lectureship (Assistant Professorship) and Ph.D.

c) Selected through a National level examination conducted by MoE or its agencies / Institutions such as UGC/ IIT/ IISc./ IIIT etc.

(d) Selected provisionally for the DST-INSPIRE Fellowship (provisional award letter to be produced

e) Minimum of TWO years of professional experience (acquired after obtaining the qualifying degree and completed before the starting of the semester in which admission is sought) OR with UGC-NET (Ph.D. only)

Marks / CGPA / CPI requirement in Qualifying Degrees (listed above):

For GN/EWS/OBC (NC) category

(a) a minimum of 60% marks in aggregate, OR

(b) a First Class as specified by the University, OR

(c) a minimum Cumulative Grade Point Average (CGPA) / Cumulative Performance Index (CPI) of 6.0 on the scale of 0-10, OR

(d) an equivalent to 6.0 on other corresponding proportional requirements when the scales are other than 0-10.

(e) For Master's or equivalent degree in Arts or equivalent degree in Humanities and Social Sciences subjects, a minimum of 55% marks will be considered for admission to the Ph.D. programmes offered ONLY by Department of Humanities & Social Sciences.

For SC/ST/PwD category

(f) a minimum of 55% marks in aggregate, OR

(g) a First Class as specified by the University, OR

(h) a minimum Cumulative Grade Point Average (CGPA) / Cumulative Performance Index (CPI) of 5.5 on the scale of 0-10, OR

(i) an equivalent to 5.5 on other corresponding proportional requirements when the scales are other than 0-10.

(j) For master's or equivalent degree in Arts or equivalent degree in Humanities and Social Sciences subjects, a minimum of 50% marks will be considered for admission to the Ph.D. programmes offered ONLY by Department of Humanities & Social Sciences

A.5.2) – For TA/RA category,

All Bachelor's degree undergraduate course leading to a Bachelor's, Integrated Master's or Bachelor-Master Dual Degree in Engineering, Sciences or Architecture offered by IITs (admitted through JEE) having a CGPA/CPI score of 8.00 (on the scale of 10) and above from an Indian Institute of Technology are exempted from the requirement of a valid GATE score for the consideration of General Eligibility Requirement for admission.

A.5.2a) – For TAP/RAP category,

All Bachelor's degree undergraduate course leading to a Bachelor's, Integrated Master's or Bachelor-Master Dual Degree in Engineering, Sciences or Architecture offered by IITs (admitted through JEE) having a CGPA/ CPI score of 8.00 (on the scale of 10) and above from an Indian Institute of Technology or any of the CFTIs are exempted from the requirement of a valid GATE score for the consideration of General Eligibility

In addition to general eligibility criterion, the applicants must also satisfy the eligibility criteria specified for the respective Departments / Centres / Schools / Interdisciplinary Groups.

Over and above the general eligibility criteria for admission, candidates need to satisfy additional criteria for financial support / fellowship, as specified under specific admission categories [Please refer section 6.0].

The final selection process to DDD programme to any Departments / Centres / Schools / Interdisciplinary Groups at IIT Bombay will be through written test and/or interview as specified by individual Department / Centre / Schools / Interdisciplinary Groups.

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A.6) APPLICATION CATEGORIES AND FINANCIAL SUPPORT

A.6.1) Teaching Assistantship (TA) [Financial support as per MoE norm]

A candidate, applying for the Ph.D. Programme, at IIT Bombay will be eligible for the financial support under the TA category subject to the fulfillment of General eligibility criterion as specified in A.5 except point No. A.5.1 (e).

All Bachelor's degree undergraduate course leading to a Bachelor's, Integrated Master's or Bachelor-Master Dual Degree in Engineering, Sciences or Architecture offered by IITs (admitted through JEE) having a CGPA/CPI score of 8.00 (on the scale of 10) and above from an Indian Institute of Technology are exempted from the requirement of a valid GATE score for the consideration of General Eligibility Requirement for admission.

The assistantship is payable for a maximum duration of 5 years or up to the thesis submission, whichever is earlier. The monthly rate of assistantship is Rs. 37,000/- for the first 2 years and enhanced rate of Rs. 42,000/- for the remaining period.

The continuation of assistantship under TA category will be subject to serving as a teaching assistant in a course / laboratory for 8 hours per week as assigned by the concerned academic unit as well as satisfactory academic performance. The assistantship will be paid on the basis of monthly attendance.

As per MoE directives, the employees on the rolls (with or without pay) of any organization are not eligible for admission under this category.

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A.6.2) Research Assistantship (RA)

A candidate, applying for the Ph.D. Programme, at IIT Bombay will be eligible for the financial support under the RA category subject to the fulfillment of General eligibility criterion as specified in A.5 except point No. A.5.1 (e).

All Bachelor's degree undergraduate course leading to a Bachelor's, Integrated Master's or Bachelor-Master Dual Degree in Engineering, Sciences or Architecture offered by IITs (admitted through JEE) having a CGPA/CPI score of 8.00 (on the scale of 10) and above from an Indian Institute of Technology are exempted from the requirement of a valid GATE score for the consideration of General Eligibility Requirement for admission.

The assistantship is payable for a maximum duration of 5 years or up to the thesis submission, whichever is earlier. The monthly rate of assistantship is Rs. 42,000/- for the first 2 years and enhanced rate of Rs.47,000/- for the remaining period.

The information of availability of RA seats will be available with / published by individual academic units.

Students admitted under RA category will have to look after the laboratories and also assist in teaching or research or other related academic work for about 20 hours per week as assigned by the concerned academic unit. Continuation of assistantship will remain subject to the satisfactory performance in assigned duties as well as satisfactory academic performance. The assistantship will be paid on the basis of monthly attendance.

The employees on the rolls (with or without pay) of any organization are not eligible for admission under this category.

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A.6.3) Teaching / Research Assistantship Through Project (TAP/RAP)

A candidate, applying for the Ph.D. Programme, at IIT Bombay will be eligible for the financial support under this category subject to the fulfillment of the General eligibility criterion as specified in A.5 except point No. A.5.1 (e).

The financial support under this category is provided from sponsored projects as per the norms approved by the sponsoring agency and IITB. In case a specified norm is not available, the same approved by MoE/DST will apply.

All Bachelor's degree undergraduate course leading to a Bachelor's, Integrated Master's or Bachelor-Master Dual Degree in Engineering, Sciences or Architecture offered by IITs (admitted through JEE) having a CGPA/ CPI score of 8.00 (on the scale of 10) and above from an Indian Institute of Technology or any of the CFTIs are exempted from the requirement of a valid GATE score for the consideration of General Eligibility.

The assistantship is payable for a maximum duration of 5 years or up to the thesis submission, whichever is earlier.

The information of availability of TAP/RAP seats will be available with / published by individual academic units.

The continuation of assistantship under TAP / RAP category will be subject to serving for the project as assigned by the concerned project investigator (s) as well as satisfactory academic performance.

The assistantship is paid from the office of Dean, IRCC.

As per MoE directives, the employees on the rolls (with or without pay) of any organization are not eligible for admission under this category.

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A.6.4) Fellowship Award (FA)

A candidate, applying for the Ph.D. Programme, at IIT Bombay will be eligible for the financial support under this category need to fulfill the General eligibility criterion as specified in A.5 except point No. A.5.1 (e).

The financial support under this category is provided by various Govt. / Semi Govt. schemes (CSIR, UGC, DAE,DST, DBT, NBHM, etc.) and some other organizations.

A valid Junior Research fellowship (JRF) award letter from the Govt. / Semi Govt. agencies (e.g. CSIR/UGC /DAE /DST/ DBT NBHM etc.) is required for the execution of this fellowship.

The amount and duration of the fellowship will be as specified by the awarding agency. The disbursement and continuation of the fellowship will be subject to as per the norms specified by the awarding agency or as specified by IIT Bombay for TA category, as deemed fit.

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A.6.5) Institute Staff of IIT Bombay (IS)

This category is only for the 'permanent' persons employed as Institute Staff at IIT Bombay.

A candidate, applying for the Ph.D. Programme, at IIT Bombay under this category need to fulfill the General eligibility criterion as specified in A.5.

(i) The candidate should have been employed as Institute Staff for at least 2-years (before the starting of the semester in which admission is sought) AND after completion of qualifying degree. The candidate must produce a letter of work experience at the time of application.

(ii) The concerned academic unit will shortlist the eligible candidates. Admission will be on the basis of written test and interview as applicable to the concerned programme. The candidates need to submit NOC, from the Head/Office-In-Charge, at the time of application.

(iii) If an employee admitted under this category is not serving as an Institute Staff while pursuing the degree, then he/she cannot continue under the IS category but may seek for changing his/her category to self-financed (SF) category through proper channel.

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A.7) ADMISSION PROCEDURE

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. Merely satisfying the general eligibility criterion as well as criterion set for each admission category is no guarantee for being called for test/interview. Depending on the number of applications received and considering the constraints of time and other resources for conducting Written Test and Interview, the Academic Units may put additional academic performance based shortlisting criterion.

Candidates called for the written Test/Interview under Teaching Assistantship (TA) category, only candidates belonging to SC/ST and PwD categories will be paid single second class return railway fare by the shortest route (as per rules) from their place of residence to the Institute. They have to produce evidence (Original/Photocopy of Railway Ticket) in support of their claim. A candidate called for more than one discipline, can submit only one claim.

A.8) PAYMENT OF FEES AND DEPOSITS

Various fees and deposits for the programme **- as available on the following webpage**

https://acad.iitb.ac.in/admissions/fees-structure

A.9) REGISTRATION FOR THE DDDP 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 degree. This application will be considered by the Departmental Postgraduate Committee (DPGC) 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 registration for all candidates is FIVE/SIX years from the date of confirmation of registration (Registration is confirmed as per rules, after successfully completion of course credit requirements).

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A.10) CONFIRMATION OF REGISTRATION

All Ph.D. Admissions are provisional until the “Confirmation of Registration” is completed. This confirmation takes place after six months to a year after admission, and only if academic performance criterion set by the department is met. Some academic units (departments / interdisciplinary groups / centres / schools) prescribe a qualifier examination for the Ph.D. Programme. These must be completed successfully prior to to confirmation of registration. Failure to meet satisfactory performance criterion may lead to termination of studentship.

Ref.: Rules & Regulations for Ph.D. Programme,

http:Computer//www.iitb.ac.in/academichome/rules.jsp

A.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/three 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 student's eligibility for award of the degree of Doctor of Philosophy.

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1.0 OVERVIEW - IITB-TU DDDP

IIT Bombay (IITB) and Tohoku University (TU), Japan, share a longstanding collaboration that has evolved into a strategic partnership in recent years. The initial institutional partnership agreement was established in 2000, encompassing education, scientific cooperation, and student exchange programs. This agreement has been renewed periodically to further strengthen and sustain the partnership. A major milestone was the signing of a Memorandum of Understanding (MoU) in December 2024 to expand research collaboration and mobility initiatives. This was followed by the Cotutelle PhD MoU in April 2025, formally establishing the Double Doctoral Degree Program (DDDP). A dedicated unit — the *IITB–Tohoku University Japan Collaboration Cell* — has been constituted to centrally facilitate this DDDP admission process. All rules governing regular PhD admissions at IIT Bombay will be applicable to this program as well.

This is a Double Degree Programme. Upon successful completion, the student will receive two certificates, with a single thesis and one joint defence, supervised collaboratively by faculty from IIT Bombay and TU Japan. The student is required to spend one to two years at TU Japan as part of the programme. Tuition fees are exempted at TU, and are payable only at IIT Bombay. IIT Bombay will provide the stipend during the student's stay at IITB, while TU will support the student financially during the period in Japan. For further details, please visit the link.

https://www.ir.iitb.ac.in/iitb-tu

The DDDP currently covers ten priority research areas: Artificial Intelligence & Machine Learning, Digital Health, Disaster Mitigation, Energy & Sustainability, Materials Science, Quantum Computing, Robotics, Semiconductors, Thermals & Fluids, and Transportation.

Each of these themes is inherently interdisciplinary, cutting across multiple Departments, Schools, and Research Centres. This structure encourages cross-pollination of ideas, collaborative problem-solving, and the development of innovative solutions that transcend traditional disciplinary boundaries. Each identified research domain is led by designated Faculty Leads (FLs), who are responsible for steering domain-specific academic and research activities.

2.0 RESEARCH THEME-WISE ELIGIBILITY CRITERIA

2.1 AI & ML

2.1.1 ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% marks for SC/ST), as specified in the General Eligibility Criteria, in any of the following qualifying degrees:

i) M.E./M.Tech/M. S in any Engineering or Technology discipline
ii) B.E/BTech in any Engineering discipline
iii) M.Sc. or equivalent in any science, statistics, or mathematical discipline.
iv) 4-year Bachelor of Science degree such as B.S., B.Sc. (with Honours), B.Sc. (with Research) in any science, mathematical, or engineering discipline.
v) MBA (with B. Tech/B. E or an equivalent degree)

For candidates qualifying under (ii), (iii), or (iv), any one of the following additional requirements must also be fulfilled:

k) Valid GATE score
l) A four-year or five-year degree from the IITs, IISc, IISERs or a Master's degree from ISI (any two-year Master's degree), with CPI (normalized to a 10-point scale) >= 8
m) Minimum two years of professional work experience (acquired after obtaining the qualifying degree and completed at the time of submitting the admission application)
n) Note: Criteria for awarding Teaching Assistantship and other application categories are as per the guidelines as prescribed by IIT Bombay.

2.1.2 COURSE REQUIREMENTS

Given the diverse academic backgrounds of the students, five breadth topics have been defined, and the students are required to obtain proficiency in each of them. The topics are: Computing, Probability & Statistics, AI/ML, Linear Algebra, Optimization. A basket of IIT Bombay courses that provide the requisite background in each of these areas has been created (i.e. the same courses as prescribed by CMInDS https://www.minds.iitb.ac.in/admissions). Additionally, a wide variety of elective courses can be taken.

2.2 DIGITAL HEALTH

The Digital Health theme offers a unique program focused on the intersection of technology and healthcare. We will be actively investigating digital health solutions, emphasizing the application of AI/ML, bioengineering principles, and cutting-edge biosciences to address critical challenges in health and medicine. This PhD program is intended to promote an interdisciplinary ecosystem where expertise from biology, engineering, health sciences, and medicine converge to drive impactful innovation through this bilateral collaborative initiative.

2.2.1 SPECIFIC RESEARCH AREAS WITHIN THIS THEME:

BIOSCIENCES (BS)

Biophysics and Computational Biology, Biochemistry, Cell Biology, Immunology, Genetics and Molecular Biology, Proteomics, System Biology, and Biomarkers of infectious diseases. Biologics, antibodies production and engineering, virology, infectious diseases, enzyme engineering etc.

BIO-ENGINEERING (BE)

Sensors and Devices, Application of AI/ML in health care applications and devices, Biomaterials, Drug delivery, and tissue engineering, Nanobiotechnology, Biomedical Optics, Computational Biology and Bioinformatics, Biomedical Informatics and Physiology.

Digital Health: Healthcare Applications of EHR, EMR and clinical applications, Medical imaging etc., Healthcare Data Management: Data interoperability and standards, Data Privacy and Security, Healthcare Analytics and AI/ML, Computational Biology and Bioinformatics, Large Language Models in Healthcare.

2.2.2 ELIGIBILITY FOR ADMISSION

i) M.Tech./M. E. or equivalent degree in Biotechnology, Biomedical Engineering, Chemical Engineering, Computer Science / Engineering, Electrical Engineering, Electronics / Telecommunications Engineering, Instrumentation Engineering, Mechanical Engineering, Engineering Physics, Optics / Optoelectronics / Photonics, Robotics, Robotics Engineering, Automation and Robotics, Mechatronics, Data Science and Artificial Intelligence, Data Science and Engineering, Artificial Intelligence, Engineering Sciences.

ii) M.Pharm. OR MBBS with MD/MS, MVSc, MDS, MPTh, MOTh, MS/MD Health sciences AYUSH.

iii) B.Tech./B.E. or equivalent degree in Biotechnology, Biomedical Engineering, Chemical Engineering, Computer Science / Engineering, Electrical Engineering, Electronics / Telecommunications Engineering, Instrumentation Engineering, Mechanical Engineering, Engineering Physics, Optics / Optoelectronics / Photonics, Robotics, Robotics Engineering, Automation and Robotics, Mechatronics, Data Science and Artificial Intelligence, Data Science and Engineering, Artificial Intelligence, Engineering Sciences.

iv) M.Sc. or 5-year Integrated B.S.-M.S. program or equivalent degree in Life Sciences, Biochemistry, Biophysics, Biotechnology, Ceramics, Chemistry, Electronics, Ergonomics, Material Science, Mathematics, Molecular Biology, Physics, Bioinformatics, Data Science, Physiology, Cognitive Science, Neuroscience, Photonics / Optics / Optoelectronics

v) Health Sciences (such as MBBS (Medicine) / BDS (Dental), B.Pharm/B.V.Sc., B.P.Th., B.O.Th., B. ASLP, Pharma D (duration 4 years or more). Candidates with these backgrounds and degrees, should have qualified one of the following: All India level postgraduate entrance examinations for corresponding disciplines such as INI_CET/NEETPG/NEET MDS/JIPMER/PGI Chandigarh/AFMC-Pune/DNB Part I/AIIPMR for MBBS/ BDS, GPAT/ All India level selection examination for B.Pharm. All India level postgraduate entrance examination such as AIIPMR for M.V.Sc., M.P.Th., M.O.Th. and M. ASLP, GATE examination for all such health science background where applicable. Eligibility/rank certificates for all such All-India level entrance examinations are required. The candidate should have qualified in the entrance exam (as per the qualification criterion of the respective exam for that exam year and category), and the score obtained should be valid (as per the duration of validity for the respective exam) at the time of admission to the Ph.D. program.

Candidates with qualifying degrees in [iii and iv] must fulfil one of the following: a valid GATE score for TA/TAP/RA/RAP), a valid CSIR/UGC/DBT JRF, or a valid ICMR JRF not linked to ICMR project or any other fellowship that will provide scholarship for five years. For candidates with qualifying degrees as in (i) to (v), and applying under SW category, experience [as specified in A.5 and A.6 in PhD brochure] is mandatory.

2.2.3 TOTAL COURSE CREDIT REQUIREMENTS

Eligibility Criteria	**Minimum Credits Requirement**
B.Tech/BE/BPharm/MBBS/BDS/BOTh/BVSc	44-56 credits
M.Sc/M.Pharm/ MBBS+MS/ MBBS+MD/ MDS/ MVSc/MPTh/MPTh	34-46 credits
M.Tech/ME (BT Group)	22 credits
M.Tech/ME in Biomedical Engineering (for BME Group)	22-34 credits
Other M.Tech or Equivalent (for BME group)	34 credits
A 4 credit Seminar Course (BBS801) (within the total credit requirement) is mandatory for all.	
BB899 Communication Skill course is mandatory for all and for BSBE students this course will run only in Autumn Semester (July to December semester).	
A Seminar and a Communication Skill course is mandatory for all (within the total credit	

requirement).

2.2.4 PhD QUALIFIER [COMPREHENSIVE EXAM]

Students are required to qualify the PhD qualifier [comprehensive exam] after first year with 80% marks.

2.3 DISASTER SCIENCE AND MANAGEMENT

2.3.1 DEPARTMENTS

Disaster Science and Management is an inherently cross-disciplinary field of study. IIT Bombay has taken up this field in partnership with Tohoku University with the expectation to break traditional boundaries of traditional specialisations, and develop new knowledge and tools to address disaster risk reduction. During the initial phase of the Double Degree Doctoral Partnership with Tohoku University, Disaster Science and Management Focus Area will have faculty participation from Civil Engineering Department, Earth Sciences Department and Shailesh J Mehta School of Management.

2.3.2 ADMISSION

Based on the objectives of this focus area and the need to attract outstanding candidates from various fields of prior study, admission to the PhD program will depend on the topic of study. In turn, this will depend on the requirements of the home department of the supervising faculty members. As per prevalent norms, students can be admitted after completing their M.Tech. degree. However, highly meritorious students can be admitted to the PhD program directly after completing their Bachelor's degree as per IITB norms.

2.3.3 MINIMUM COURSE REQUIREMENT

The course requirement for Disaster Science and Management Focus Area students will be same as that of the parent department of the supervising faculty. For example, a student selected for PhD under the supervision of Professor A of SJMSOM has to fulfil all requirements of SJMSOM as applicable to other PhD students of Professor A who are directly admitted to SJMSOM. Similarly, another student selected for PhD under the supervision of Professor B of Civil Engineering Department has to fulfil all requirements of Civil Engineering Department as applicable to other PhD students of Professor B who are directly admitted to Civil Engineering Department. The requirements will also include Qualifier requirements as applicable to the home department of the supervising faculty member. Where applicable, the minimum CPI criteria of the home department of the supervising faculty member shall also be fulfilled.

2.4 ENERGY AND SUSTAINABILITY

This PhD program provides a deep, interdisciplinary exploration of sustainable energy systems. Doctoral candidates will pursue groundbreaking research in fields like renewable energy, carbon management, and sustainable fuels, driving the innovation required for a global energy transition.

2.4.1 CORE RESEARCH AREAS & THRUSTS

The program will be built around several interdisciplinary research thrusts, each with a brief description:

Research Area	Description & Key Focus Areas
1. Renewable Energy Systems	Focuses on the generation, integration, and optimization of energy from renewable sources. - **Solar Energy:** Photovoltaic (PV) materials, system design, and grid integration. - **Wind Energy:** Aerodynamics, turbine technology, and offshore wind systems. - **Geothermal & Hydropower:** Advanced exploration and low-impact system design.
2. Solar Cell Technology	Next-generation photovoltaic materials and devices for higher efficiency and lower cost. - **Perovskite Solar Cells:** Development of stable, scalable fabrication methods. - **Tandem & Multi-Junction Cells:** Combining materials to capture a broader light spectrum. - **Organic & Thin-Film PV:** Lightweight, flexible solar applications.
3. Energy Storage Devices	Critical for managing the intermittency of renewables and electrifying transport. - **Battery Technologies:** Solid-state batteries, lithium-sulfur, and post-lithium (e.g., sodium-ion) chemistry. - **Hydrogen Storage:** Advanced materials for safe and compact storage (metal hydrides, adsorbents). - **Thermal & Mechanical Storage:** Molten salts, compressed air energy storage (CAES), and flywheels.
4. Hydrogen Economy	Encompasses the entire value chain of hydrogen as a clean energy vector. - **Green Hydrogen Production:** Advanced electrolysis (PEM, AEM) using renewable electricity. - **Hydrogen Utilization:** Fuel cell development for vehicles and stationary power. - **Hydrogen Safety & Infrastructure:** Materials compatibility and pipeline transport.
5. Biofuels & Bioenergy	Developing sustainable fuels from biological sources. - **Advanced Biofuels:** Algal biofuels, cellulosic ethanol, and biomass gasification. - **Waste-to-Energy:** Thermochemical and biochemical conversion of municipal/agricultural waste. - **Sustainability Assessment:** Life-cycle analysis (LCA) of bioenergy systems.
6. Carbon Capture, Utilization, and Storage (CCUS)	Focuses on removing CO_2 from point sources and the atmosphere and converting it into valuable products. - **Direct Air Capture (DAC):** Developing novel sorbents and solvents for efficient atmospheric CO_2 removal.

Research Area	Description & Key Focus Areas
	- **Point-Source Capture:** Advanced amine scrubbing, membrane separation, and calcium looping for industrial and power plant emissions. - **Carbon Utilization:** Catalytic conversion of CO_2 into fuels (e.g., methanol), chemicals, and building materials (mineralization). - **Geological Sequestration:** Modeling subsurface transport, monitoring, verification, and risk assessment for stored CO_2.
7. Carbon Neutral & Negative Systems	Research on entire systems and ecosystems that achieve net-zero or net-negative carbon emissions. - **Bioenergy with Carbon Capture and Storage (BECCS):** Integrating biomass energy conversion with CCS for negative emissions. - **Circular Carbon Economy:** Designing systems where carbon is continuously recycled rather than emitted. - **Carbon-Neutral Infrastructure:** Life-cycle design of buildings, industrial processes, and urban systems for net-zero operational and embodied carbon.
8. Sustainable Fuels for Aerospace	Developing low-carbon and zero-carbon energy carriers for aviation and space. - **Sustainable Aviation Fuels (SAFs):** Production via hydroprocessed esters and fatty acids (HEFA), alcohol-to-jet (ATJ), and power-to-liquid (PtL) pathways. - **Liquid Hydrogen (LH2):** Production, lightweight cryogenic storage, and combustion for aircraft. - **Ammonia & Synthetic Kerosene:** As carbon-free and drop-in compatible fuels for turbines. - **Propulsion System Adaptation:** Modifying turbine engines and fuel systems for alternative fuels.

2.4.2 ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% marks for SC/ST), as specified in the General Eligibility Criteria, in any of the following qualifying degrees:

i) M.E./M.Tech/M. S in any Engineering or Technology discipline
ii) B.E/BTech in any Engineering discipline
iii) M.Sc. or equivalent in any science, statistics, or mathematical discipline.
iv) 4-year Bachelor of Science degree such as B.S., B.Sc. (with Honours), B.Sc. (with Research) in any science, mathematical, or engineering discipline.
v) MBA (with B. Tech/B. E or an equivalent degree)

For candidates qualifying under (ii), (iii), or (iv), any one of the following additional requirements must also be fulfilled:

a) Valid GATE score
b) A four-year or five-year degree from the IITs, IISc, IISERs or a Master's degree from ISI (any two-year Master's degree), with CPI (normalized to a 10-point scale) >= 8
c) Minimum two years of professional work experience (acquired after obtaining the qualifying degree and completed at the time of submitting the admission application)

Note: Criteria for awarding Teaching Assistantship and other application categories are as per the guidelines as prescribed by IIT Bombay.

2.4.3 COURSE REQUIREMENTS

Given the diverse academic backgrounds of the students and the interdisciplinary nature of the research area in the Energy and Sustainability theme, the courses relevant to the thrust areas in this theme are listed below. These courses are chosen to cover a wide range of research areas.
The core courses can be chosen based on the following tentative list of courses, depending on the area of research and approval of the PhD advisor. More courses can be added on the recommendation of PhD advisors, depending on the area of research in the Energy and Sustainability theme. The credit requirements are according to the Rules and Regulations of the Ph.D programme of IIT Bombay (Rule R.4).

2.4.3.1 List of courses

Code	Name	Category	Basket
EN 601	Nonconventional Energy Sources	Department Elective	**Energy Science and Engineering**
EN 602	Foundation for Energy Engineering	Department Elective	
EN 606	Energy Resources, Economics and Environment	Department Elective	
EN 618	Energy Systems Modelling & Analysis	Department Elective	
EN 615	Wind Energy Conversion Systems	Department Elective	
EN 624	Conservation of Energy in Buildings	Department Elective	
EN 630	Utilisation of Solar Thermal Energy	Department Elective	
EN 640	Solar Photovoltaic, Fundamentals, Technologies and Applications	Department Elective	
EN 642	Power Generation and Systems Planning	Department Elective	
EN 649	Introduction to Particulate Flow	Department Elective	
EN 651	Multiphase Petroleum Transportation	Department Elective	
EN 657	IC Engine, Alternate Fuels and Emissions	Department Elective	
EN 658	Electrochemical Energy Storage	Department Elective	
EN 663	Electric Vehicle Grid Integration	Department Elective	
EN 665	Power Converters for Electric Vehicle Charging	Department Elective	
EN 703	Advanced Concepts in Solar Cell Technologies	Department Elective	
EN 323	Renewable Energy Generation and Storage	Department Elective	
EN 401	Energy Systems modelling and analysis	Department Elective	
EN 409	Mathematical Foundation for Energy Science	Department Elective	
AE 683	Fluid Dynamics	Department Elective	Aerospace Engineering
AE 711	Aircraft Propulsion	Department Elective	
AE 726	Heat Transfer - Aerospace Applications	Department Elective	

AE 708	Aerospace Propulsion	Department Elective	
AE 755	Optimization for Engineering Design	Department Elective	
AE 780	Computational Heat Transfer and Fluid Flow	Department Elective	
AE 738	Tensors for Engineers	Department Elective	
AE 725	Air Transportation	Department Elective	
AE 705	Introduction to Flight	Department Elective	
AE 656	Aviation Fuels and their Combustion	Department Elective	
AE 653	Engineering Mathematics	Department Elective	
CE 626	Groundwater Systems Planning and Management	Department Elective	Civil Engineering
CE 641	Environmental Geomechanics	Department Elective	
CE 680	Mechanics of Water Waves	Department Elective	
CL 601	Advanced Transport Phenomena	Department Elective	Chemical Engineering
CL 607	Advanced Thermodynamics	Department Elective	
CL 665	Sustainable Engineering Principles	Department Elective	

2.5 MATERIALS

The general eligibility criteria prescribed by IIT Bombay are bare minimum and mere possession of same will not entitle the applicants to be called for written test/interview. The Department may restrict the number of applicants to be called for written test/interview to a reasonable limit, on the basis of qualifications and experience higher than that of the minimum prescribed in the advertisement. The candidate must satisfy the eligibility criteria in either one of the following qualifying degrees:

i. M.Tech./ M.E. or equivalent degree in Engineering/Technology.
ii. B.Tech./B.E. or equivalent degree in Engineering/ Technology.
iii. M.Sc. Or equivalent degree in Chemistry, Materials Science, Physics and related science streams. Mathematics as a subject at the B.Sc. Level is mandatory.

2.5.1 RESEARCH AREAS

a) Physical and Mechanical Metallurgy:

microstructure, microstructure evolution, phase equilibrium, phase transformation, structure property relationship, thermomechanical processing and texture analysis, metal forming, super plasticity, mechanical behaviour- creep, fatigue, micromechanics, fracture mechanics

b) **Process Metallurgy and Manufacturing:**

process modelling, process analysis, iron and steel making (including clean steel production), non-ferrous extractive metallurgy, welding, powder metallurgy, additive manufacturing, E-waste processing refractories, Non-ferrous production, Sustainable metal production, powder Metallurgy and additive manufacturing

c) **Structural Ceramics:**

high temperature ceramics, inorganic glasses and glass-ceramics, ceramic foams, ceramic coatings, industrial ceramics, ceramic synthesis/processing, sintering, near net shape forming, gel casting, rheology of suspensions, mechanical and tribological behavior.

d) **Electronic, Magnetic and 2D Materials:**

electrical and optical properties, magnetic properties, dielectric and piezoelectric properties, electrochemical behavior, 2D materials, quantum and correlated materials, thin films synthesis/processing/devices

e) **Energy Materials:**

materials and devices for photovoltaic, advanced battery, supercapacitor, fuel cell, thermoelectric and sensing applications, nanoscale materials synthesis/ processing/ devices

f) **Polymers and Soft Matter:**

crystallization and self-assembly in soft matter (polymers, proteins) systems, polymer blends and polymer nanocomposites, polymer thin films and membranes, polyelectrolytes, surface and interfacial phenomena in soft materials, dynamics in polymer confinement, thermodynamic, mechano-rheological, mechanical properties of polymers, responsive, functional and conjugated polymers

g) **Corrosion and Coatings:**

Aqueous corrosion, the metallurgy of corrosion, corrosion in oil and gas, atmospheric corrosion, corrosion inhibitors, and protective coatings (functional organic coating, galvanization, electroplating, and high-temperature coatings), electrochemistry, interface degradation

h) Modelling and simulation:

First principles-DFT, Monte Carlo, molecular dynamics, CALPHAD, phase field, phase field crystal, cellular automata, dislocation dynamics, crystal plasticity, plastic deformation and material flow, finite element.

2.5.2 COURSE REQUIREMENTS

2.5.2.1 Course Requirements for students admitted with M-Tech degree

Four full-semester courses (minimum 24 credits)

- 2 fundamental courses (from list of 6 courses shown below)
- 2 specialization courses relevant to the research area (600-level and above)
- One Ph.D. seminar course (4 credits) (can be with any faculty including PhD guide)
- Total credits – 28 minimums (Institute requirement 22 credits + Dept. requirement 6 credits)

2.5.2.2 Course requirements for students admitted with B.Tech./M.Sc. Degree

- 7 courses (minimum 42 credits)
- 6 full-semester courses

  - 2 fundamental courses (from list of 6 courses shown below)
  - 4 specialization courses relevant to the research area (600-level and above)

- 1 elective for 6 credits or more – can be 2 half-semester courses. UG/PG as per institute rules
- 1 Ph.D. seminar course (can be with any faculty including PhD guide) – 4 credits minimum
- Total credits – 46 minimums (< institute requirements of maximum credits 56)

2.5.2.3 List of Six Fundamental Courses

- Thermodynamics of Materials (MM 651)
- Diffusion and Kinetics (MM 677)
- Electronic Properties of Materials (MM 685)
- Mechanical Behaviour of Materials (MM 730)
- X-ray diffraction and Electron Microscopy (MM 684)

- Structure and Defects (MM 759)

2.5.2.4 Guidelines for Selection of Specialisation Courses

- Must be relevant to the research area – preferably selected in consultation with PhD guide
- Students need to justify their choices to show relevance to their research area/ thesis
- One specialization course can be a 600 or higher level from outside the department
- If additional specialization courses are from outside the department (600-level and above),
- strong additional justification must be provided

2.6 QUANTUM TECHNOLOGY

The TU-IITB dual-doctoral-program in the Q. Tech theme will encompass research and development in all four verticals of quantum technology: Computation, Communication, Sensing and Materials. At IITB, the faculty involved in Q. Tech research are affiliated with the departments of Physics, Electrical Engg., MEMS, Sys Con, CS, IEOR and Chemistry. Many of these faculty are also affiliated with the IITB Center of Excellence in Quantum Information, Computation, Science and technology (CoE-QUICST) which has started the Interdisciplinary Dual Degree M. Tech program from the Autumn, 2025 semester. Given the diversity of backgrounds of the involved faculty, the PhD topics will range from investigations of fundamental aspects of quantum matter and information to applied technology related questions.

2.6.1 ELIGIBILITY FOR ADMISSION

The eligibility criteria shall, by default, be the same as those of the academic unit with which the supervising faculty is affiliated. As per prevalent norms, students can be admitted after completing their MTech/MS degree (Category A); subject to certain additional conditions, meritorious students can also be admitted to the PhD program directly after completing their BE/BTech/BS/BSc(4yrs)/MSc degree (Category B).

2.6.2 COURSE REQUIREMENTS

The course requirement for the Q. Tech PhD program will, by default, be the same as that of the academic unit with which the supervising faculty is affiliated. For example, a student selected for PhD under the supervision of Professor E with affiliation to Programme X shall fulfil all requirements of X as applicable to other PhD students of Professor E who are directly admitted to X. It is noted that the course requirements for students in admissions category A and B are typically different. For example, the credit requirements in the department of Physics are: 34 (for students with M.Sc.), 16 (for students with M.Tech./M.E.), 44 (for students with B.Tech./B.E./B.S.). Exceptions to the above course requirements may be permitted on a case-by-case basis by the supervisor as allowed by the latter's departmental rules based on the need for customization and/or breadth.

The requirements will also include Qualifier requirements as applicable to the home department of the supervising faculty member. Where applicable, the minimum CPI criteria of the home department of the supervising faculty member shall also be fulfilled.

2.6.3 LIST OF RECOMMENDED COURSES

While the course requirements of the supervisor's department apply as above, the following existing courses are recommended towards a strong foundation in quantum information science and technology. This list may be reviewed annually, and revised as needed. For students with little formal exposure to relevant courses for Q. Tech these courses may be recommended:

1. Quantum Mechanics (PH225 or PH403)

2. Electronic Devices and Circuits (EE207)
3. Digital Electronics (EE221)
4. Digital Systems (EE224)
5. Signal Processing, I (EE229)
6. Design and Analysis of Algorithms (CS218)
7. Data Structures and Algorithms (CS213)
8. Discrete Structures (CS105)
9. Introduction to Condensed Matter Physics (PH436)
10. Electronic Devices and Characterization (PH207)
11. Electronic properties of materials (MM318)

For students at the expected level of preparation for PhD work these courses may be recommended: Compulsory (one from each basket)

Basket A:

1. Quantum Computation and Information-I (PH534)

Basket B:

1. Introduction to Quantum Engineering (EE801)
2. Nanoscale Quantum Transport (PH576)
3. Quantum Transport in Nanoscale Devices (EE755)

Electives:

1. Theoretical Condensed Matter Physics (PH557)
2. Electronic Devices Laboratory (EE236)
3. Nano-magnetism and Spintronics (EE751)
4. Topological electronics (EE787)
5. Quantum Computation and Information-II (PH601)
6. Quantum Optics (PH546)
7. Light Matter Interaction (PH530)
8. 2D Materials and Devices (EE784)

2.7 ROBOTICS

2.7.1 ELIGIBILITY FOR ADMISSION

(i) M.Tech./M. E. or equivalent degree in Aerospace Engineering, Biomedical Engineering, Biomechanics, Chemical Engineering, Computer Science / Engineering, Data Science and Artificial Intelligence, Electrical Engineering, Electronics / Telecommunications Engineering, Engineering Physics, Industrial Engineering, Instrumentation Engineering, Mechanical Engineering, Mechatronics, Production Engineering, Robotics, Robotics Engineering, Robotics and Automation, Systems and Controls.

(ii) B.Tech./B.E. or equivalent degree in Aerospace Engineering, Biomedical Engineering, Biomechanics, Chemical Engineering, Computer Science / Engineering, Data Science and Artificial Intelligence, Electrical Engineering, Electronics / Telecommunications Engineering, Engineering Physics, Industrial Engineering, Instrumentation Engineering, Mechanical Engineering, Mechatronics, Production Engineering, Robotics, Robotics Engineering, Robotics and Automation, Systems and Controls.

(iii) Candidates with qualifying degrees in [ii] must fulfil one of the following: a valid GATE score (for TA/TAP/RA/RAP), a valid CSIR/UGC/DBT JRF, or a valid ICMR JRF not linked to ICMR project or any other fellowship that will provide scholarship for

five years. For candidates with qualifying degrees as in (i) and (ii), and applying under CT, EX, IS, PS, or SW category, experience [as specified in A.5 and A.6 in PhD brochure] is mandatory. In addition, the sponsoring organisation must give No Objection Certificate for the candidate to spend part of the time (1-2 years) in Tohoku University.

2.7.2 MINIMUM COURSE CREDIT REQUIREMENTS

Eligibility Criteria	Minimum Credits Requirement
B. Tech/BE	44 credits
M.Tech/ME	16 credits
A Seminar and a Communication Skill course is mandatory for all (within the total credit requirement).	

2.8 SEMI CONDUCTOR

The semiconductor focus area is intended to cover all aspects of the field – materials, processes, equipment, device design and fabrication, packaging, circuit and system design, design automation – as well as the interfaces hereof. Given that innovation in this area is often industry-driven, there will be a preference for industry-aligned topics.

2.8.1 ELIGIBILITY FOR ADMISSION

The eligibility criteria shall, by default, be the same as those of the academic unit with which the supervising faculty is affiliated (may be the primary, or, a secondary affiliation). As per prevalent norms, students can be admitted after completing their MTech/MS degree (Category A); subject to certain additional conditions, meritorious students can also be admitted to the PhD program directly after completing their BE/BTech/BS/BSc(4yrs)/MSc degree (Category B).

2.8.2 COURSE REQUIREMENTS

The course requirement for the semiconductor focus area students will, by default, be the same as that of the academic unit with which the supervising faculty is affiliated (may be primary, or, a secondary affiliation). For example, a student selected for PhD under the supervision of Professor E with affiliation to Programme X shall fulfil all requirements of X as applicable to other PhD students of Professor E who are directly admitted to X. It is noted that the requirements for students in admissions category A and B are typically different.

Exceptions to the above course requirements may be permitted on a case-by-case basis by the supervisor. It is envisaged that considerations for exception could be customization and/or breadth. The following basket of existing foundational courses is recommended for the purpose of affording breadth. The basket may be reviewed annually, and revised as needed.

EE 671 – VLSI Design; EE 705 – VLSI Design Lab; EE 699 – VLSI Technology; EE 733 – Solid State Devices; EE 735 – Microelectronics Simulation Lab

ME 768 – Introduction to Microsystems Packaging; ME 6110 – Nanomanufacturing Processes
MM 685 – Electrical Materials: fundamentals and applications; MM 762 – Materials Processing in Semiconductor Technology – part I; MM 764 – Materials Processing in Semiconductor Technology – part II

Besides these, supervisors and students may opt for relevant electives from across departments, especially Electrical, MEMS, Mechanical and Physics. The requirements will also include Qualifier requirements as applicable to the home department of the supervising faculty member. Where applicable, the minimum CPI criteria of the home department of the supervising faculty member shall also be fulfilled.

2.9 THERMO-FLUID

This is an interdisciplinary program where the research is of both fundamental and applied in nature. The PhD program comprises an elaborate course-work for learning the required foundations and advanced concepts in the broad domain of thermo-fluids and a PhD thesis.

2.9.1 ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% marks for SC/ST) in the qualifying degree with any one of the following:

i) M.Tech./M.E. or equivalent degree in Mechanical Engineering, Aerospace Engineering, Chemical Engineering, Laser Technology, Biomechanics.
OR,
M.Tech./M.E. or equivalent degree in other branches of Engineering/Technology with an outstanding academic record for research areas consistent with the academic background of the candidates.

ii) B.Tech./B.E. or equivalent degree in Mechanical Engineering, Aerospace Engineering, Chemical Engineering, Laser Technology, Biomechanics
OR
B.Tech./B.E. or equivalent degree in other branches of Engineering/Technology with an outstanding academic record for research areas consistent with the academic background of the candidates.

iii) M.Sc or equivalent in Physics, Chemistry, Applied Mathematics, or a relevant engineering sciences discipline.

iv) 4-year Bachelor of Science degree such as B.S., B.Sc (with Honours), B.Sc (with Research) in Physics, Applied Mathematics, or a relevant engineering sciences discipline.

For candidates qualifying under **(ii), (iii), or (iv)**, any one of the following additional requirements must also be fulfilled:

a) Valid GATE score (Please note that this score may be specific to the concerned department of the home institution. For instance, candidates applying for admissions under Mechanical Engineering Department, this requirement is 600 (Gate score)).
b) A four-year or five-year degree from the IITs, IISc, IISERs or a Master's degree from ISI (any two-year Master's degree), with CPI (normalized to a 10-point scale) >= 8
c) Minimum two years of professional work experience (acquired after obtaining the qualifying degree and completed at the time of submitting the admission application)

Note: Criteria for awarding Teaching Assistantship and other application categories are as per the guidelines as prescribed by IIT Bombay.

2.9.2 MINIMUM COURSE CREDIT REQUIREMENTS:

For category **i)**: Minimum 16 credits
For categories **ii, iii or iv**: Minimum 44 credits.

2.9.3 COURSE REQUIREMENTS:

Given the interdisciplinary nature of the domain, six broad topics have been defined, and the students are required to obtain proficiency through registering for the relevant course(s) run by the concerned department of the home institution.

Fluid Mechanics; Thermodynamics; Heat Transfer; Numerical Methods (including CFD,); Measurements/Experimental methods; Applied Mathematics.

A basket of IIT Bombay courses that provide the requisite background in each of these areas has been created. A representative list of courses for each of these baskets is produced below for reference (please note the list given is not exhaustive and only provides courses for representation purpose):

i. Fluid Mechanics (*ME651, ME724, AE683, CE731, EN418*)
ii. Thermodynamics and Heat Transfer (*ME661, ME663, ME662, EN418, AE726, CL4404*)
iii. Numerical Methods (*ME668, ME704, ME613, AE706, AE780*)
iv. Measurements/Experimental methods (*ME619, ME226, ME743, AE724, CE675*)
v. Applied Mathematics (*ME673, ME621, AE653, CL460, EN409*)

Please note that based on the minimum credit requirements (as stated above) that need to be fulfilled, the candidate has the flexibility to choose/select courses considering the core theme of his/her PhD research work and in consultation with the supervisor(s). Additionally, a wide variety of elective courses can also be taken.

2.10 TRANSPORTATION

The Transportation Theme under the IIT Bombay–Tohoku University DDDP is a highly interdisciplinary initiative focusing on both fundamental and applied aspects of research in areas such as smart mobility, intelligent transportation systems, cyber–physical models, robotics, infrastructure planning, technology policies, high speed rail, transit-oriented development, public transport, infrastructure financing, sustainable urban development, etc. The program aims to nurture scholars with strong analytical, computational, and experimental capabilities to address emerging challenges in transportation and smart cities through a blend of scientific innovation and real-world applications. Given that advancements in this domain are often industry-driven, there will be a preference for candidates proposing research directions aligned with industry or societal needs.

2.10.1 ELIGIBILITY FOR ADMISSION

First Class or 60% marks (55% marks for SC/ST candidates), as specified in the General Eligibility Criteria, in any of the following qualifying degrees:

i) M.E./M.Tech. /M.S. or equivalent in any branch of Engineering or Technology
ii) B.E./B.Tech. in any Engineering discipline
iii) M.Sc. or equivalent in any Science, Statistics, or Mathematical Science discipline
iv) 4-year Bachelor of Science degree such as B.S., B.Sc. (Honours), or B.Sc. (Research) in any Science, Mathematics, or Engineering discipline
v) MBA (with B.Tech./B.E. or an equivalent undergraduate degree)

For candidates qualifying under (ii), (iii), or (iv), any one of the following additional requirements must also be fulfilled:

a. Valid GATE score (cutoff as per IIT Bombay)
b. A four- or five-year degree from IITs, IISc, IISERs, or a Master's degree from ISI (2-year program) with CPI ≥ 8 (on a 10-point scale)
c. Minimum two years of professional work experience (acquired after obtaining the qualifying degree and completed at the time of application submission)

NOTE: Criteria for awarding Teaching Assistantships, other fellowships and other categories of admission (such as self-finance, project staff category) shall be as per the guidelines prescribed by IIT Bombay and respective academic units/departments).

2.10.2 COURSE REQUIREMENTS:

Given the cross-disciplinary nature of transportation research, and depending upon the specific research topic and academic requirements of the student, suitable courses may be drawn from multiple departments such as Civil Engineering, Computer Science and Engineering, Electrical Engineering, Mechanical Engineering, Data Science and Artificial Intelligence, Robotics, and Systems and Control, among others.

The coursework will include foundational and advanced topics from these domains to ensure both breadth and depth of technical knowledge. Students must also satisfy all Qualifier, course work requirements, and minimum CPI requirements as prescribed by the home department at IIT Bombay. A mandatory communication skill course and a research seminar may also form part of the credit requirement.

STATEMENT OF PURPOSE FOR ALL ACADEMIC UNITS

Statement of Purpose (SOP) is your opportunity to share with the admission committee your thoughts and feelings about Postgraduate studies at IIT Bombay including your preparation for the same. Briefly describe past project/ research work done by you. Restrict yourself to 500-600 words. The personal SOP will aid the admission committee in evaluating your application.

(i) Along with your application, you have to submit a Statement of Purpose or a Research Proposal as required by an academic unit.

Name: _____

IIT BOMBAY AND TOHOKU UNIVERSITY JAPAN (IITB-TU) Double Doctoral Degree PROGRAM (DDDP) Programme in i)_____

ii) _____

iii) _____

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