

7. Indian Institute of Technology Madras, Chennai 600 036 –MD

In all cases the eligibility requirement for consideration for admission to Ph.D is a First Class or Equivalent with a minimum of 60% marks or 6.5/10 CGPA for General and OBC candidates and minimum of 55% marks or CGPA of 6.0/10 for SC/ST candidates in the qualifying Masters degree in Engineering/Technology/Science as indicated under minimum qualifications in the table given below for different departments. Minimum marks or CGPA is to be based on all the years/semesters of the qualifying examination put together.

Code	Department	Fields of Specialization	Minimum Qualification
MDAE01	Aerospace Engineering	<p>Aerodynamics: Helicopter Aerodynamics, Geo-Physical Fluid Dynamics, Subsonic, Transonic, Supersonic, Hypersonic, Shock and Blast Wave Dynamics (Theoretical and Experimental), Rarefied Gas flows (Theoretical and Experimental), Boundary Layers and Stability of Flows, Turbulent Flows, Shock Tubes and Related Problems, Development of Algorithms and Code for Numerical Methods in Gas Dynamics and Computational Fluid Dynamics, Vortex Dynamics, Supersonic Mixing and Combustion, Optical Flow Diagnostics, Linear and Nonlinear Acoustics.</p> <p>Aircraft Structures: Finite Element Methods, Numerical Methods, Composite Structures, Fatigue and Fracture Mechanics, Contact Mechanics, Vibration and Impact Mechanics, Constitutive Modelling.</p> <p>Aerospace Propulsion: Rocket Propulsion and Solid Propellant Combustion, Airbreathing Propulsion and Combustion, Cascade Flows, Multiphase Flow Simulation, Combustion Instability, Optical Flow/Combustion Diagnostics.</p> <p>Dynamics & Control: Non-Linear Dynamics in Aerospace Applications, Computational Methods in Nonlinear Dynamics, Nonlinear Control Theory and Applications, Flight Simulations and Controller Development, Design Development of Autonomous Flying Vehicles.</p>	<p>Master's degree or its equivalent in Aerospace/ Civil/ Applied Mechanics/ Mechanical/ Chemical or Master's degree in Mathematics/ Physics and aptitude for research. Science Post- graduates should have exceptional merit and research or industrial experience in the appropriate field. Candidates with Master's degree in other allied engineering specializations can also be considered provided they have either basic degree in Aerospace Engineering or atleast five years experience in Aerospace industry/ Research Organisation.</p>
MDAM02	Applied Mechanics	<p>Biomedical Engineering :- Cardiovascular System studies, image and Signal Processing, Speech Signal Processing, Ultrasound and Laser instrumentation in Medicine, Biomechanics, Rehabilitation Engineering, Evoked Response and Functional Electrical Stimulation, Physiological Modeling, Biomaterials, Biosensors, Medical Diagnostics. Cellular biomechanics, Neuromechanics.</p> <p>Fluid Mechanics:- Laser Diagnostics, Turbulent Convection, Computational Fluid Dynamics (CFD), Bluff body and Industrial Aerodynamics, Fluid Structure Interaction, Experimental Fluid Mechanics, Sprays and multiphase flows.</p> <p>Solid Mechanics:- Computational and Experimental studies in fatigue, fracture, smart materials, photo elasticity, plasticity, vibrations, control, composites, biomechanics, constitutive modeling and stochastic mechanics.</p>	<p>Biomedical Engineering area:- Master's degree in Applied Mechanics / Civil / ECE / Mechanical/ Electrical/ Biomedical Engineering/ Computer Science/ Instrumentation/ Metallurgical Engineering.</p> <p>Fluid Mechanics area:- Master's degree in Applied Mechanics / Civil / Mechanical / Aerospace / Chemical/ Biomedical Engineering/ Engineering Mechanics</p> <p>Solid Mechanics area:- Master's degree in Civil/ Aerospace/ Mechanical/ Naval Architecture, Production Engineering with an aptitude for research in Solid Mechanics.</p>
MDCH01	Chemical Engineering	Transport and Reaction Engineering, Systems and Control, Biochemical Engineering, Environmental Engineering, Materials and processes	Master's degree in Chemical Engineering
MDCY01	Chemistry	Inorganic Chemistry, Organic Chemistry and Physical & Theoretical Chemistry	Master's degree in Chemistry.

Code	Department	Fields of Specialization	Minimum Qualification
MDBT01	Biotechnology	<p>Research Areas The department focusses on a wide array of research topics, reflecting the diversity of modern biotechnology. The four thrust areas of Research (M.S. and Ph. D.), are listed here:</p> <p>I. Biological Sciences Molecular oncology • Cancer immunotherapy • Anti-cancer nutraceuticals • HIV pathogenesis • Stem cell biology • Biomarkers for cardiovascular disease • Gene regulation in hypertension • Molecular and cellular basis of cardiovascular complications • Structure - function relationship of ion channels • Ion channels associated with ischemic heart diseases and stroke • Nanoparticles • Nanobiotechnology of food packaging • Nucleolar GTPases and cell proliferation • Pattern formation in cellular slime moulds • Plant developmental genetics • Recombinant Enzymes • Biofuel cells • Biorefinery</p> <p>II. Biological Engineering Industrial metabolite production • Metabolic engineering • Biopolymers • Biocompatibility • Biodegradation of polymers • Tissue engineering • Caffeine degradation • Membrane biochemistry • Plant cell bioprocessing • Phytoremediation • Biofuels • Process chromatography • Reactive species in biological systems</p> <p>III. Computational Biology Protein structure, folding and function • Protein dynamics • Computational analysis of protein folding and stability • Binding specificity of protein complexes • Green chemistry • Structure-based drug design and discovery • Comparative genomics • Computational modeling of neurodegenerative disorders • Computational systems biology • Development and analysis of databases and tools • Computational biophysics • GPGPU computing for systems biology</p> <p>IV. Chemical Biology 'Green' biocatalytic methods for organic transformations • Delivery of siRNAs • Fragment-based drug design • Novel inhibitors against HDACs and HMT • Asymmetric catalysis.</p>	Same as for our regular Ph.D programme.
MDCE01	Civil Engineering	Building Technology & Construction Management	Master's degree in Civil, Ocean or Industrial Engg., Industrial Management or MBA after obtaining a basic degree in Civil Engineering, or in Architecture, Housing, Town & Country planning after obtaining a basic degree in Civil Engg., or Architecture with first Class.
MDCE02		Environmental and Water Resources Engineering	M.Tech or M.S. or equivalent degree in Engineering Mechanics/ Aerospace Engineering/ Agricultural Engineering/ Civil Engineering/ Environmental Engineering or M. Tech or M.S. or equivalent degree in Chemical Engineering/ Biotechnology.
MDCE03		Geotechnical Engineering	Master's degree in Civil or Ocean Engineering or Engineering Mechanics, Mining Engineers. With two years experience.
MDCE04		Structural Engineering	Master's degree in Civil, Ocean, Aerospace, Naval Architecture, Mechanical, Computer Science or in Engineering Mechanics with basic degree in Civil Engineering or Infrastructural Civil Engineering.
MDCE05		Transportation Engineering	Master's degree in Civil/ Architecture/ Town and Country Planning/ Regional Planning/ City Planning/ Urban Engineering or 2 years full time Postgraduate Diploma in Town and Country Planning with specialization in Traffic and Transportation Planning of the School of Planning and Architecture, New Delhi/ MBA after obtaining a basic degree in Civil Engineering.

Code	Department	Fields of Specialization	Minimum Qualification
MDCS01	Computer Science & Engineering	<p>Intelligent Systems and Human Computer Interaction: Artificial Intelligence, Computational Brain Research, Machine, Learning, Pattern Recognition, Visualization and Perception, Information Management, Computational Biology, Data Mining, Image Processing, Digital Speech Processing, Video Processing.</p> <p>Systems Engineering: Compiler Design, Computer Architecture, Computer Networks, Cyber-Physical Systems, Distributed Systems, Hardware and Network Security, High Performance Computing and Parallelization, Object Oriented Systems, Parallel, Distributed and Cloud Computing, Programming Languages, VLSI Design.</p> <p>Theoretical Computer Science: Algorithms, Computational Complexity Theory, Cryptography.</p>	M.Tech/M.E./M.S. in Computer Science & Engineering or Information Technology.
MDEE01	Electrical Engineering	Communications, Networks, Signal processing, Speech & Image Processing Information Theory.	Electronics & Communication Engineering.
MDEE02		Power Systems & Power Electronics.	Electronics & Communication Engineering, Electrical & Electronics Engineering, Instrumentation Engineering.
MDEE03		Micro Electronics & VLSI Design.	Electronics & Communication Engineering.
MDEE04		Control and Instrumentation.	Electrical and Electronics Engineering, Electronics and Communication Engineering, Control and Instrumentation Engineering.
MDEE05		Microelectronics.	B.E./ B.Tech. /M.Sc., in Electrical & Communication Engineering/ Instrumentation Engineering / Electrical & Electronics Engineering / Physics who qualify with GATE subject EE/EC/IN/PH.
MDEE06		Integrated Circuits and Systems.	Electronics & Communication Engineering, Electrical & Electronics Engineering, Instrumentation Engineering.
MDER01	Engineering Design	<p>Automotive Engineering: Vehicle Dynamics, Tyre Mechanics, Mathematical Modelling of Dynamic Systems, Control, Fault, Diagnosis, Automotive Systems, Intelligent Transportation Systems.</p> <p>Biomedical Design: Medical Imaging, Biomechanical Modeling, Soft Tissue Mechanics, Bio-fluid Mechanics, Prosthetic and Scaffold Design, Biomedical Devices and Control Microwave Applications, Tissue Ablation and Hyperthermia Physics, Radiometry, Ergonomics, Rehabilitation Engineering, Bio-MEMS/NEMS, Biomedical Micro/Nano devices.</p> <p>Materials and Design: Geometric and Solid Modeling, Computational Geometry, Shape Search, Shape Optimization, Image Based Reconstruction, Solid Free Form Fabrication, Design Theory, Reliability, Fatigue and Fracture, Finite Element Analysis, Digital Image Correlation, Material Characterization, Structural Health Monitoring, Design with Smart Materials, Sustainable Manufacturing.</p> <p>Robotics and Mechatronics: Parallel Manipulators, Underwater Robots, Path Planning, System Dynamics and Control, Opto-mechatronics, Sensing.</p>	Master's degree in Aerospace, Automobile, Biomedical, Civil, Computer Science, Electrical, Electronics, Engineering Physics, Instrumentation, Mechanical, Metallurgical, Material Science, Naval Architecture, Production / Manufacturing Engineering, or Master's degree in Design (Engineering) (M.Des.) or M.Tech. (Industrial Mathematics).

Code	Department	Fields of Specialization	Minimum Qualification
MDHS01	Humanities & Social Science	<ul style="list-style-type: none"> • Economics: Development Economics, Energy and Environmental Economics; Applied Econometrics; Industrial Economics; Microfinance; International Trade; Economics of Innovation and Technological Change; Health Care Economics and Public Policy; Financial Economics and Banking; Economics of Education/Labour Markets; Urban Water Management. • Education and Technology Studies: Theories of Learning; Information and Communication Technologies (ICTs) in Higher Education; Engineering Education; Engineering Ethics; Assessment and Evaluation in Higher Education; Quality Assurance. • History: Modern Indian History, History of Science, Technology and Medicine (since 1700s). • Linguistics: Language in Education; Sociolinguistics; Applied Linguistics; syntax/Morphology. • Literature and Media Studies: American Literature; English Literature; Eco-criticism; (American/British); Disability Studies; Film and Media Studies; Popular Culture; Life writing. • Philosophy: Phenomenology; Hermeneutics; Philosophies of Heidegger and Wittgenstein; Indian Philosophy; Philosophy of Mind; Consciousness; Analytical Philosophy; Philosophy of Language; Political Philosophy; Ethics; Professional Ethics (Engineering and Higher Education); Bioethics. • Politics & International Relations / Political Science: International Relations Theory; International Political Economy; Taiwan Studies; Chinese Studies; Democracy Theory and Practice. • Sociology/ Anthropology: Sociology of Religion; Islam; Sociology of Work and Gender; Anthropology of body; Anthropology of Technology; Gender Studies; Disability studies; Sociology of Science. 	Master's degree in relevant discipline.
MDMS01	Management Studies	<p>Consumer Behaviour, Positive Organizational Behaviour: Workplace Emotions, Ancient Indian Wisdom in Management, Creativity & Innovation, Cross-Cultural Research, Cognition in organizations, Corporate Sustainability: Responsible Business.</p> <p>Comparative Management Systems, Global leadership: Mindset, Potential, Practices, Work and Wellness Training & Development, Workplace teams; Career Management, Experiential Marketing, Advertising; Data Science and Analytics.</p> <p>Technology transfer, Innovation and Entrepreneurship, Experimentation and reinforcement learning, Competitiveness and business excellence, Public Systems; Supply chain and Logistics: Green concerns, healthcare and food sectors.</p> <p>Game Theoretic Models, Scheduling in manufacturing and service operations, Integrated Production, Logistics and Inventory Optimization in Supply Chain Management, Behavioural Decision Theory; Corporate Finance: Financial decision making, Venture capital and private equity, Small and medium enterprises, Infrastructure finance, Public sector finance; Real Options, Developmental Finance, Financial Markets – Capital market, Bond market, commodity market, derivatives, market microstructure, Behavioural Finance, Financial Modelling & Forecasting, Banking and risk management; E-commerce.</p>	<p>Post graduate degree in Sciences/ Social Sciences/ Humanities/ Commerce/ Engineering/ Technology/ Management.</p> <p>Above 65% (Aggregate) for Engineering, Science, Management Degree - UG (General /OBC)</p> <p>Above 60% (Aggregate) for Arts and Social Science Degree – UG (General/OBC)</p> <p>Above 55% for AMIE and other associateship - UG</p> <p>Above 60%(Aggregate) for Engineering, Science, Arts and Social Sciences Degree- If PG is required (General/OBC)</p> <p>10% relaxation for SC/ ST/ PH candidates, 5% for OBC as per GOI rules.</p>

Code	Department	Fields of Specialization	Minimum Qualification
MDMA01	Mathematics	<p>Detailed information about the specialization of each faculty member is available in the Department web site. Mat.iitm.ac.in</p> <p>Algebra: Commutative Algebra, Algebraic Combinatorics, Geometry and Topology of Toric Varieties, Group Theory, Fuzzy Algebra, Linear Algebra, Algebraic Geometry, Applications of Algebra</p> <p>Analysis: Functional Analysis, Numerical Analysis, Complex Analysis, Functional Spaces, Special Functions, Operator Equations, Inverse and Ill-posed Problems, Harmonic Analysis, Wavelets, Mathematical Programming, Game Theory, Conformal Geometry, Fixed Point Theory and Applications, Fuzzy Set Theory and Analysis, Functional Equations, Summability Theory, Spectral Approximation, Non-smooth Analysis, Optimization Theory, Sampling Theory, Approximation Theory, Control Theory,-</p> <p>Applied Mathematics: Numerical PDE, Convective Heat and Mass Transfer, Computational Fluid Dynamics, Ship Hydrodynamics, Mathematical Problems related Naval Architecture and Ocean Engineering, Mathematical Modeling, Non - linear Differential Equations. Fluid Mechanics, Bio-Fluid Mechanics, Integral and Differential Equations, Water Waves.</p> <p>Applied Probability and Stochastic Process: Applied Probability and Stochastic Processes, Operations Research, Stochastic Models, Mathematical Ecology.</p> <p>Theoretical Computer Science and Discrete Mathematics: Theoretical Computer Science, Graph Theory, Combinatorics, DNA Computing, Theory of Codes, Combinatorial Optimization, Discrete Mathematics, Formal Language, Automata Theory, Modular Computing, Approximation Algorithms.</p>	Master's Degree in Mathematics/ Statistics/ Physics/ Computer Science or M.Tech (Industrial Mathematics & Scientific Computing).
MDMM01	Metallurgical and Materials Engineering	<p>Metal casting, Metal forming, Metal joining, Materials Technology, Physical and Structural Metallurgy, Mechanical Metallurgy, Chemical Metallurgy, Thermodynamics of Metallurgical Systems, Powder Metallurgy, Ceramics and Composites, Corrosion, Surface Engineering, Biomaterials, Simulation and Modeling of Materials Processing, Nanostructured Materials, Magnetic Materials, Amorphous Alloys, Nonequilibrium Processing, Hydrogen Storage Materials, Smart Materials, Fuel Cells, Metallic Foams, Chemical Sensors, Carbon Nanotubes, Special Steels, Superalloys, Intermetallics, Materials for Optoelectronic Applications, Shape Memory Alloys, Fatigue and Fracture Mechanics, High Temperature Behaviour of Materials and Creep.</p>	Master's degree in appropriate branch of Engineering/ Technology. Engineering graduates (B.Tech/BE or equivalent) and Science postgraduates (M.Sc. or equivalent) to be considered should have exceptional merit and research or industrial experience in the appropriate field.

Code	Department	Fields of Specialization	Minimum Qualification
MDME01	Mechanical Engineering	<p>i) Design Engineering: Machine Elements ~ design development, analysis and performance improvements, New materials and design, composites, nano composites, bio materials, porous materials, radiation damage, surface engineering, design process, contact mechanics, tribology, tyre mechanics, biomechanics, fatigue and failure analysis, computational and experimental fracture mechanics, fatigue crack closure – environment interaction studies, alternate small specimen test methods, small crack propagation under biaxial multiaxialloading, multi crack interaction studies, fatigue damage in composites, failure mechanics of biomaterials. Non linear finite element analysis, Vibration, finite element including coupled problems, Non destructive evaluation, structural health monitoring, Materials Characterization, Measurements of Material Properties and Behavior, machinery signal processing, Condition monitoring of structures machines, machinery diagnosis, and combustion flame noise, Acoustics and Noise Control, Prosthetics and human body movement, Design optimization, constitutive modeling, MEMS, Rotor Dynamics.</p> <p>(ii) Manufacturing Engineering: Manufacturing Processes, Technologies, CAD/CAM, Manufacturing Planning and Control, Metrology and Computer Aided Inspection, Quality Control, Materials behaviour in Manufacturing, Surface Treatment, Machining Process, Condition Monitoring, Flexible Manufacturing Systems, Computer Integrated Manufacturing, Non Traditional Machining; Precision Gearing, Micro manufacturing, Friction Stir Welding Manufacturing Methods in Precision Engineering, Surface Technology, Active Noise Control systems, Active Suspensions, Microprocessor Based System Design, Electrohydraulic Servo and Proportional Controls, Pneumatic Systems, Robot-Kinematics, Dynamics, Design and Controls, Multibody Dynamics, System Simulation, Microhydraulics, Mechatronics, Microactuators, MEMS</p> <p>(iii) Thermal Engineering: Micro-miniature and small cryogenic refrigerators, Simulation and optimization of air separation cycles, Heat Transfer in Nano-fluids, Heat Transfer in Multi-Phase Flows, Flow Structure Interaction in High Speed Turbo machinery Seals, Heat Transfer Experiments in Phase Change Material Based Composite Heat Sinks, Two Phase Flow Convection Experiments and Numerical Methods in Porous Media, Solid State Hydrogen Storage, Sorption heating and cooling systems, Desiccant/evaporative cooling and air-conditioning, Conjugate heat transfer in low and high speed flows, Retrieval of geophysical parameters in the atmosphere in the microwave and infra red regions, Turbine rotor stator interaction, Performance improvement of centrifugal compressor by tip modification, subsonic cascade studies, Contrarotating turbines/compressors, Mixed flow compressors, Turbine blade cooling, Secondary loss reduction, Cavitation in hydraulic machines, Micro-scale Flows, Microfluidics, Free Surface flows, Acoustics of Supersonic Jets, Active and Passive Control of High speed flows, Combustion noise, Emissions, Combustion, Propulsion, CFD high speed reacting flows, I.C Engine Combustion and Emissions, alternative fuels, CFD applications in I.C Engines and Gas turbine combustion chambers, fluid flow, heat transfer and combustion related to I.C Engines, advanced I.C Engine technologies such as homogeneous charge, compression ignition, gasoline direct injection, engine management (Simulation of engine processes and modeling – Combustion diagnostics in engines Heat Transfer in Fuel Cells, Fluidized Bed Combustion, Solar Power Systems, Optimization of Solar Ics Systems. Nano fluidics.</p>	Master's degree in Mechanical Engineering, Aerospace Engineering, Automobile Engineering, Automotive Engine Tech., Bio-Medical Engineering, Chemical Engineering, Computer Science, Electrical Engineering, Electronics, Energy Engineering, Industrial Engineering, Instrumentation, Maintenance Management, Metallurgical Engineering, Production/ Manufacturing Engineering, Agricultural Engineering and in related areas depending on the research topics.

Code	Department	Fields of Specialization	Minimum Qualification
MDOE01	Ocean Engineering	<p>Ocean engineering : Wave-structure interaction, Soil-structure interaction, Hydrodynamics of fixed, floating and compliant offshore structures, Port and harbor structures, Coastal structures, coastal processes and shore protection, Subsea pipelines, risers and cables, Remote sensing and ocean optics, Ocean renewable energy - wind, wave, current and OTEC, Offshore structural engineering,- Ocean and underwater acoustics, and Ocean environment.</p> <p>Marine vehicles : Motion and stabilization, Maneuvering and controllability, Resistance, powering and propulsion systems - Design and surface development, Shipbuilding materials, structure and vibrations, under water vehicles, hydrodynamics and control, under water acoustics – under water towed systems and marine CFD.</p>	Master's degree with good academic record and exceptional merit in Aerospace Engineering, Civil Engineering, Marine Engineering, Mechanical Engineering, Marine Structures, Naval Architecture, Ocean Engineering Or any other appropriate engineering discipline Or M.Sc. in Physics, Mathematics, Statistics or Oceanography.
MDOE02		<p>Petroleum engineering: Reservoir engineering; Reservoir Simulation; Analysis of seismic data and interpretation, Artificial lift methods, Drilling engineering and drilling fluids, Enhanced oil recovery, Flow assurance technologies, Formation evaluation from well logging methods, Gas hydrate studies, Hazards identification and risk management, Petroleum geology and geophysical studies, Flow through shale gas reservoirs, CBM reservoirs, fractured carbonate reservoirs and CO₂ sequestration.</p>	Master's degree with good academic record and exceptional merit in Chemical Engineering, Civil Engineering, Marine Engineering, Mechanical Engineering, Marine Structures, Naval Architecture, Ocean Engineering, Petroleum Engineering Or any other appropriate engineering discipline OR M.Sc. in Physics, Mathematics, Statistics, Oceanography, Geology and Geophysics.
MDPH01	Physics	Applied Optics, Quantum Optics, Photonics and nonlinear optics, Atomic and Molecular Physics, Complex fluids, Soft Condensed Matter and Biological Physics, Low temperature physics and superconductivity, Magnetism and Magnetic materials, Semiconductor Physics, Photovoltaics, Dielectric materials & Microwave Physics, Spintronix Multifunctional materials. Thin film phenomena, Metal-oxide Thin films, Nanostructured thin film and heterostructures, Low Dimensional Materials, Carbon Nanotubes and Graphene, Hydrogen Storage Materials, Dynamical systems, Statistical Physics and Field Theory, Electronic structure of Solids and Computational Material Science, Nonlinear Dynamics, Quantum Chaos, Quantum Information, Particle Physics and Experimental High Energy Physics, Gravity and Cosmology, Theoretical High Energy Physics.	M.Sc/ M.Sc (Tech) in Physics, Applied Physics, Materials Science/ M.Tech (Solid State Technology) / M.Tech. (Materials Science) M.Tech (functional Materials and Nano Technology)or equivalent.