

Mechanical Engineering

机械工程

(080200)

1. Overview of the Program

This program is the broad mechanical engineering field to develop and construct. It solves the science and technical problems of design, performance achievement and optimization of mechanical product using the basic theory of mechanical engineering and studies the theory and technology of mechanical products as well as traditional vehicle, unmanned vehicle, intelligent connected vehicle, new energy vehicle, bionics and robot, power machinery, fluid machinery and also studies the theory and technologies includes intelligent manufacturing, sensing and mechatronic control, opto-electronics micro-nanofabrication science and engineering, engineering thermophysics.

This program is a full-time degree, including both coursework and project. It aims at cultivating the high-level specialized personnel with a firm grasp of basic theories and professional knowledge of mechanical engineering, having the ability to solve practical problems and undertake the tasks for professional technology or management. They will participate in projects in mechanical engineering under the guidance of their advisors and complete their graduation thesis based on the projects they have conducted.

Dedicated to the development of general mechanics, mechanical engineering program contains two first-class disciplines – mechanical engineering, power engineering and engineering thermophysics. The mechanical engineering discipline in Beijing Institute of Technology was founded in 1943 in Yan'an Academy of Natural Science and began to enroll graduate students in 1955. In 1981, the second-class discipline named Vehicle Engineering was authorized to offer the doctorate degree, followed by power machinery and engineering offering second-class discipline doctorate degree in 1993. Mechanical engineering was selected as one of the earliest disciplines that offers first-class discipline doctorate degree in 1998, and power engineering and engineering thermophysics began to offer first level discipline doctorate degree in 2017. Mechanical engineering discipline was selected as one of the earliest national key disciplines in 2007, and also ranked as “mechanical engineering” discipline category A in 2017.

As the discipline that cultivated the first tank in China, mechanical engineering serves as an important research and teaching base for armored vehicle design. Based on the great needs of national security, mechanical engineering has developed the transmission design theory for armored vehicles and cultivated the top-rated armored vehicle in the world. Aiming at the development of national key emerging industries, electric commercial vehicle design platform was generated. The platform cooperated with 15 new-energy vehicle industry members and the outcome has been successfully applied on the electric vehicles used in the transportation systems in APEC. It's worth noted that through years of explorations and innovations, the electric commercial vehicle technology was successfully exported to European Union. As one of the most important national platform, the "electric vehicle big data collaboration platform" was built to monitor electric vehicle, and provides EV design requirements for domestic vehicle industry. Mechanical engineering is actively engaged in the "Made in China 2025" strategy, a novel micro-nano machining technology based on dynamic control of instantaneous electron was proposed to reduce the height of recast layer by 60%. The machining efficiency was improved 50 times and depth-diameter ration/depth-width ratio limit was increased by 30 times. This technology was selected as one of the sixteen national science and technology major projects for the machining of micro holes on the target sphere. Mechanical engineering also conducts systematic and cooperative research in unmanned vehicle, humanoid robot and other innovative technologies.

There are now 77 professors and 88 doctoral supervisors in mechanical engineering discipline. Among them, one professor is academician of Chinese Academy of Engineering (CAE) and one is foreign academician of Chinese Academy of Sciences (CAS), 47 faculties entered national high-level talent plans such as Changjiang Distinguished Professor, distinguished young scholars, 511 Talents of National Defense and National Recruitment Program. The discipline has seven innovation teams sponsored by Ministry of Education, Ministry of Industry and Information Technology and Ministry of Science and Technology, four national research platforms including 2011 cooperative innovation center, eleven provincial research centers and two centers was selected as Overseas Expertise Introduction Center for Discipline Innovation (111 Center). The area of our laboratories is over 32 thousand square meters, and the total assets of facilities reach RMB 520 million.

The main research directions in Mechanical Engineering of BIT include:

(1) Vehicle Theory and Unmanned Vehicle Technology. Focusing on the theory and integration of vehicle system, vehicle dynamics, simulation, NVH, vehicle reliability, vehicle new driveline theory and technology; system technology, perception, path planning, control, testing and evaluation of unmanned vehicles; multi-ground platforms cooperation technology, ground-aerial unmanned system cooperation technology. It has reached international advanced level in domains such as integrated transmission of vehicles, hydraulic transmission, high-power hydraulic components, electro-mechanical transmission, and system technology of unmanned platforms.

(2) Intelligent Connected Vehicles and Electric Drive. Focusing on intelligent connected vehicles system theory, big data analysis and deep mining of vehicle, deep environment perception and multi-source information fusion, intelligent autonomous decision and dynamics control, intelligent connected vehicle architecture and information security, electric vehicle design theory & system integration and control, vehicle lightweight design method and material application, on-board energy source security and efficiency, high-efficiency and high-energy density integrated electric drive system. It is at the forefront of the world in big data analysis and mining technology of vehicle and pure electric commercial vehicle platform technology and pure electric bus application technology.

(3) Intelligent Manufacturing Engineering. Based on the “Made in China 2025” Strategic Plan, taking the major needs of the defense technology field as the background, taking the intelligent technology of all stages in the production and manufacturing as the core and training the innovative talents in the intelligent manufacturing field as its goal. The advanced processing national defense key laboratory focuses on the research of difficult-to-machine materials, high-efficiency and precision ultra-precision machining theory and tooling technology, digital design and manufacturing technology, non-destructive testing technology, intelligent assembly technology, additive manufacturing technology and intelligent production and manufacturing service technology. It has obvious features and advantages in the processing technology of difficult-to-machine materials, product manufacturing quality inspection and control and digital design and manufacturing technologies.

(4) Intelligent Robots and Systems. Focusing on the study of theoretical methods and techniques including motion bionics, multi-scale sensing and manipulation, biomechanical integration and interaction and system control and integration. It has obvious advantages and features in the research of humanoid robots and has reached the international advanced level. It is at the leading international level in the coordination and control of martial arts and other complex actions.

(5) Electromechanical Systems and Sensors. Focusing on sensing, measurement and control technology, micro-mini unmanned system design and integration, advanced control and drive technology, information and integrated electronic control technology and non-destructive testing theory and technology. It has obvious advantages and features in the intelligent control and ultrasonic detection of unmanned systems.

(6) Opto-Electronics Micro-Nano Fabrication Science and Engineering. Facing the frontier basic science and common technology problems in micro-nano fabrication, highlighting the unique advantages of multi-disciplinary integration of photo-machine-electricity; focusing on micro/nano design theory and methods, micro-nano mechanical watch/interface behavior and control, laser micro-nano fabrication, micro-structured composite processing technology and precision mechanical system assembly theory and technology. It has distinctive features in the micro-nano system design, laser micro-nanometer manufacturing, precision/micro-structure composite processing and assembly technology, in which the femtosecond laser micro-nano processing mechanism and method living in the international advanced level.

(7) Engineering Thermophysics. The research area of engineering thermophysics is oriented to the needs of the national energy strategy. Based on the aerodynamic thermodynamics, fluid dynamics, heat and mass transfer of heat engines, the theoretical methods and key technologies for energy efficient used in thermal systems are studied. The main research contents include: thermal cycle and its work process, high-efficiency combustion theory and technology, thermal management of thermal system, theory and method of waste heat recovery of thermal system, complex combined cycle and its adjustment technology. Significant research features have been formed in the areas of efficient combustion, thermal management, and efficient thermal cycling.

(8) Power Machinery and Engineering. The research area of power machinery and engineering is based on internal combustion engines, heat turbines, internal combustion generators, and other new types of power machinery and systems. Based on engineering thermodynamics, fluid mechanics, solid mechanics, materials science, engineering control theory, and modern design methods, the basic theory and key technologies for the efficient, reliable and clean conversion of this form of energy into directly exploitable mechanical or electrical energy is studied. The main research contents include: overall design and performance optimization of power system, power system control theory and technology, reliability and vibration noise of power mechanical structure, turbocharger and emission purification, design of new concept power machinery and system. Among them, the highly-enhanced

internal combustion engine digital design theory, key components reliability technology, internal combustion engine electronic control and supercharging have outstanding advantages in China.

(9) Fluid Machinery and Engineering. In response to major engineering needs in national defense and energy, research is conducted on the functional transformation laws of fluid mechanical devices, the flow processes of complex systems, and key technologies in fluid dynamics. The main research contents include: the internal flow characteristics and control of bladed fluid machinery, cavitation flow mechanism and numerical model research, fluid dynamics in vehicle and power system, the internal flow characteristics of low-temperature medium in high-speed turbo-pump, unsteady flow and fluid-structure interaction, noise prediction and control of fluid machinery, optimal design of fluid machinery, integrated optimal design of water-jet propulsion system and underwater vehicle, and optimal design theory and key technology development of advanced composite propellers. In the high-speed hydrodynamics, especially the cavitation flow and the internal flow stability of fluid machinery, the program has formed a significant research feature.

(10) Energy and Environmental Engineering. The research area of energy and environmental engineering is mainly engaged in the research of pollutant generation mechanism, emission control technology, and pollutant monitoring technology in the process of energy conversion and utilization. It focuses on the research of various pollutant generation mechanisms, control technologies, on-line monitoring technologies, pollutant control regulations and pollution control technology policies; the research of the generation mechanism of various types of conventional and unconventional pollutants in the process of energy conversion and utilization, the mechanism of action and contribution rate of pollution in the atmospheric environment, the impact of various types of pollution sources on indoor and in-vehicle environments and on human health, and the energy utilization and environmental protection system engineering research. The discipline of energy and environmental engineering integrates the disciplines of thermal sciences, mechanics, materials science, machinery manufacturing, environmental sciences, and electromagnetic radiation, thus it is a composite discipline of energy, environment, and control.

(11) New energy Science and Engineering. The research area of new energy science and engineering focuses on the research of renewable energy such as solar energy, hydrogen energy, and biomass energy, and has connections with energy, materials, chemistry, physics, and biology. This research area studies the basic theory and key technologies for the efficient conversion and utilization of renewable energy. The main research contents include: hydrogen energy and fuel cell's theory and key

technologies, hybrid power system energy management and control technology, solar energy efficient utilization theory and technology, high density Power battery system technology, development of new energy and new power devices, etc. This research area formed leading research features in the solar thermal utilization, seawater desalination and hydrogen internal combustion engine development.

2. Training Target

The target is to train high-level innovative talents who have a good knowledge of international common sense, with the ability of spreading Chinese and foreign cultures occupied, so that to bring international graduate students into full play as a cultural bridge.

(1) Master student

Master students trained in this subject should have good research ethics and professionalism. They should master the solid basic theory and systematic expertise of the discipline, master the modern experimental methods and the skills of the discipline, and have the ability to engage in scientific research or undertake specialized technologies independently. They should be capable of performing scientific research, engineering design, product development and teaching in research institutes, companies, and universities.

(2) Ph.D. student

The Ph.D. students cultivated in this subject should have the scientific spirit and the international perspective. They should master a solid and broad basic theory and systematic in-depth expertise of the discipline; master the modern experimental methods and skills of the discipline. They have a certain degree of International academic communication skills; be capable of conducting scientific research independently. They also need to have a good spirit of cooperation, and be able to make creative achievements in scientific research or technical expertise. Ph.D. students should also master solid and basic theory, systematic specialized knowledge in the field of mechanical engineering, modern experimental methods and skills, international academic exchange ability, the capability of being engaged in scientific research independently, good cooperation spirit and be able to make creative achievements in scientific research or expertise.

3. Length of Schooling

The basic length of schooling for master students is 2 years. In principle, students should complete the courses in the first academic year. Thesis work time should not be less than one year. The maximum length of study for master students is extended by 0.5 years on the basis of 2 years.

The basic length of schooling for Ph.D. students is 4 years. In principle, students should complete the courses in the first academic year. Thesis work time should not be less than three years. The maximum length of study for Ph.D. students is extended by 2 years on the basis of 4 years.

4. Curriculum and Credit Requirements

Course Classification	Course Code	Course Name	Course Hours	Credits	Semester	Requirements	Master /Ph.D.	Credits Requirement	
Public Course	3700001	Chinese Language 汉语	96	3+3	1+2	Compulsory	Master /Ph.D.		
	3700002	Outline of China 中国概况	32	2	1/2	Compulsory	Master /Ph.D.		
Major Basic Course	0301001	Introduction to Advanced Engineering Mathematics 高等工程数学导论	48	3	2	Compulsory	Master /Ph.D.	Master \geq 2 Ph.D. \geq 2	
Optional Course	Major Core Courses	0301002	Fundamentals of Modern Control Theory 现代控制理论基础	48	3	2	Compulsory	Master	Among the Credits of Major Core Courses: Master \geq 2 Ph.D. \geq 2
		0301003	Advanced Mechanical Vibration 高等机械振动	48	3	1	Compulsory	Master	
		0301004	Advanced Engineering Thermodynamics and Heat Transfer	48	3	2	Compulsory	Master	

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			高等工程热力学和传热学					
		0301005	Computational Fluid Dynamics 计算流体力学	32	2	2	Compulsory	Ph.D.
		0301006	Advanced Control Engineering 先进控制工程	32	2	1	Compulsory	Ph.D.
		0301007	Fatigue Life Design of Mechanical Structure 机械结构疲劳与寿命设计	32	2	1	Compulsory	Ph.D.
	Major Optional Courses	0301008	Elasticity 弹性力学	32	2	1	Optional	Master
		0301009	Structural Optimization Method 结构优化方法	32	2	1	Optional	Master
		0301010	Modern Measurement Technology 现代测试技术	32	2	2	Optional	Master
		0301011	Principle of Finite	32	2	2	Optional	Master

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			Element Method 有限元原理						
		0301012	Principle and Application of CAD/CAM/CAE AE CAD/CAM/CAE 原理及工程应用	32	2	1	Optional	Master	
		0301013	Engineering Management 工程管理	32	2	2	Optional	Ph.D.	
		0301014	Cutting Theory and Advanced Machining Processes 切削理论与先进制造基础	32	2	1	Optional	Ph.D.	
		0301015	Advanced Technology of Modern Vehicle 现代车辆先进技术	32	2	2	Optional	Ph.D.	
Total Credits		Master≥18 credits			Ph.D.≥12 credits				

Notes:

1. Public Course

(1)Chinese Language: Set by International Students Center of BIT. All international students must take this compulsory course.

(2)Outline of China: Set by International Students Center of BIT. All international students must take

this compulsory course.

2. Major Basic Course

Different Programs can set their own Major Basic Course.

3. Optional Course

Master international students must take two optional courses of their own Program. Under the guidance of the supervisor, Master international students can take undergraduate courses if needed.

Ph.D. international students can take undergraduate courses if needed.

(1) Major Core Course

Different Programs can set their own Major Core Course.

(2) Major Optional Course

5. Practice Part

(1) Academic Activity (1 credit)

International Graduate Students need to participate in academic activities, academic lectures and academic conferences of their own fields. Giving oral speeches on academic conferences, whether on or off campus, are highly recommended.

(2) Innovative Practice (1 credit)

International Graduate Students should take scientific research training and social practices during their training period, which should be carried-out and evaluated by supervisors.

6. The Dissertation Related Work

(1) Literature Review & Opening Report

Under the guidance of the supervisor, International Graduate Students should pick a research direction as well as reading certain amount reference books, both Chinese or foreign languages, at the same time.

Master students should write a literature review, no less than 4000 words, based on the reading of over 30 papers, both Chinese or foreign languages, of their own research field.

Ph.D. students should write a literature review, no less than 5000 words, based on the reading of over 50 papers, both Chinese or foreign languages, of their own research field.

On the basis of the Literature Review, the Opening Report should mainly introduce following factors: research target, research meaning, methods of research, technical route, implementary plan, arrangements and expected results.

(2) Mid-Term Evaluation

Schools organize Mid-Term Evaluation for International Students, which includes the evaluations of course study, literature review, opening report and the research progress of publishing papers and writing of Degree thesis.

(3) Thesis Writing and Thesis Pre-Defense (for Ph.D. students)

International Graduate Students should complete a Degree thesis under the guidance of supervisors. Ph.D. students can take the Thesis Pre-Defense after finishing a supervisor-approved first draft.

(4) Thesis Defense

After thesis approved and the Sub- Committee of Degree Assessment authorized, International Graduate Students can take the Thesis-Defense.

(5) Degree Conferment

International students should acquire certain academic results as regulated when applying for a Master or Ph.D. Degree. Each program should clarify the categories of Master Degree and Ph.D. Degree.

Time nodes of relevant procedure

The Dissertation Related Work	Master	Ph.D.
Literature Review& Opening Report	Before week 1 of the 3 rd semester	Before week 1 of the 5 th semester
Mid-Term Evaluation	week 1-2 of the 4 rd semester	Before week 1 of the 7 th semester
Thesis Pre-Defense	——	Before Blind review
Thesis Defense	At least 9 months after the Opening Report	At least 18 months after the Opening Report
Degree Application	The application should be raised in a certain time after the Thesis Defense	

7. Course Syllabus

Course Code, Course Name, Class Hour, Credits, Course Description and Course Target, Teaching Method, Evaluation and Exams, Suitable Specialty, Prerequisites, Course Contents, Reference.