

附件 4:

## 控制科学与工程国际博士研究生培养方案

授予学位类别:

一级学科 (专业类别) 代码名称:

0811 控制科学与工程

二级学科 (专业领域) 代码名称:

081100 控制科学与工程

081101 控制理论与控制工程

081102 检测技术与自动化装置

081103 系统工程

081104 模式识别与智能系统

081105 导航、制导与控制

0811Z1 电路与系统控制

0811Z2 电力电子与传动控制

制订单位: 自动化学院 (牵头) (参与)

培养方案版本号: 2020 版

### 一、学科概况

Control Science and Engineering is a discipline of control theory, methods, techniques and engineering applications. This discipline is famous for its strong comprehensiveness, broad coverage,

solid foundation of its graduates and wide adaptivity. The discipline of control science and engineering of Central South University originated in 1958 and became one of the first master degree granting disciplines in China in 1978. It became a doctor's degree granting discipline in control theory and engineering in 1993. The control theory and control engineering was approved as a state key discipline in 2007, and then was approved to be a national defense characteristic discipline in 2017 and was assessed as A- in the fourth round of the China Discipline Ranking. This discipline has an academican of Chinese Academy of Engineering, national famous teachers, winners of national fund for Distinguished Young Scholars, Chang Jiang Scholars, IEEE fellows and other academic leading talents. Relying on the innovation research group of NSFC, national teaching team, 111 Discipline Innovation and Intelligence Introduction Base, Innovation Team of the Ministry of Education, Engineering Research Center of the Ministry of Education, Key Laboratory of Hunan Province, Engineering Research Center of Hunan Province, Innovation and Entrepreneurship Education Center of Hunan Province and other discipline platforms, and

closely concentrating on the major needs of the country, great achievements have been made in the fields of non-ferrous metallurgy intelligent optimization manufacturing, power electronic system control, artificial intelligence system theory and technology, rail transit information and control, etc. It has formed distinct research characteristics and academic advantages in the field of non-ferrous metallurgy automation, and has successively won four second prizes of national science and technology progress and one second prize of national natural science, and made important contributions to the national economic and social development and scientific and technological progress.

## 二、研究方向

(1) Process Industry Intelligent Optimization Manufacturing This research direction focuses on the automation and intelligent production of process industry, mainly including: intelligent integrated modeling and optimization control method of complex industrial process, industrial big data analysis and processing method, industrial image processing and analysis, knowledge automation system, multi-phase

and multi field coupling numerical simulation and visualization of industrial process, digital metallurgy and virtual implementation, industrial digital twin system, and so on. (2) Advanced Detection Technology and Process Monitoring This research direction aims to meet the demand of intelligent sensing and high-end automation devices in the industrial field. The research is based on intelligent photoelectric measurement technology, machine vision, multi spectral analysis, process data, new optical imaging technology, advanced optical devices, information processing and analysis of flexible sensing technology, application of intelligent sensing technology, development of advanced detection instruments and automation devices, etc. The research focuses on the safety of complex manufacturing process, and carries out process monitoring and fault diagnosis research to ensure the green, efficient and stable operation of complex manufacturing process. (3) Artificial Intelligence Technology and System In order to meet the needs of the new generation of artificial intelligence, and to help the high-quality development of the national economy, this research focuses on intelligent control and intelligent system analysis, computational

intelligence and optimization decision-making, pattern recognition and machine learning, image understanding and computer vision, unmanned system environment perception and intelligent decision-making system, industrial robot agile perception and intelligent control, etc. (4) Advanced Control Theory and System This research direction focuses on the difficulties and hot issues of complex system control, including complex dynamic system analysis and design, nonlinear control optimization theory and application, multi-agent system distributed optimization and control, aircraft control and optimization, complex electromechanical system collaborative optimization control theory and technology, quantum control, etc. (5) Control of Modern Power Electronic System In order to meet the urgent demand of high efficiency and reliability operation of modern power electronic systems such as smart micro grid, energy Internet, power Internet of things, etc., this research direction focuses on advanced power electronic equipment optimization control, power electronic power network modeling, micro grid multi machine synchronous control and decentralized collaborative control, energy network optimization control, power data analysis based on machine learning, etc. (6) Rail

Transit Information Sensing and Control In order to meet the automation and intelligent requirements of collection, transmission, processing and control of railway, urban rail and other traffic information, this research direction focuses on the rapid and precise detection technology and equipment of rail transit, fault diagnosis and intelligent operation and maintenance of high-speed train information systems, signal processing and safety monitoring of rail transit, operation control and dynamic dispatching of high-speed railway, etc. (7) Air and Space Intelligent Sensing and Control Focusing on the major future development demand of the country in the aerospace field, combining information perception, automatic control and artificial intelligence theories and methods, this direction carries out the frontier research of intelligent air and space vehicle perception and control. It mainly includes analysis and design of intelligent sensor systems, autonomous planning of intelligent aerospace vehicles, intelligent control and collaboration, intelligent aerospace target detection, recognition and tracking.

### 三、培养目标

The objectives are to inculcate the students with the high-level discipline as well as the specialized skills to pursue scientific research, technological development and engineering applications in the area of Control Science and Engineering and in other related fields. Through the program, the students should build a solid foundation of Control Science and Engineering.

#### 四、学制和学习年限

Basic length of schooling is 4 years and the longest period of schooling cannot exceed 7 years till August 31th of the end year. The management of graduate students beyond the study duration limit shall be in accordance with “The Regulations on Graduate Student Status Management of Central South University”. Doctoral students with excellent comprehensive quality can apply for graduation one year ahead of schedule, and the relevant requirements and procedures for graduation ahead of schedule should refer to “The Regulations on Graduate Student Status Management of Central South University” and “The Regulations on The Application for Graduation ahead of Schedule of Doctoral and Postgraduate

Students of School of Automation, Central South University” .

## 五、培养方式

(1) The guiding group training system in which the supervisor is responsible is implemented. The combination of the supervisor guidance and the collective guidance of the guiding group is adopted. The members of the guiding group should assist the supervisor to ensure the quality of each training stage.(2) The supervisor’s professional guidance, ideological education and academic integrity education are organically combined to guide the ideological and academic morality of students, and comprehensively cultivate and improve the comprehensive quality of students.(3) Supervisors guide students to make personal studying plans, select courses, read scientific materials, participate in academic exchanges and social practice, choose research topics, and perform scientific research, etc.(4) The discipline shall establish the elimination mechanism in the PhD training process, and strictly adapt to it. Those students who fail to pass the assessment shall be reexamined or required to quit the PhD program. Specifically, it shall be implemented in accordance with “The Regulations on Graduate Student Status Management of Central South University” and “The Regulations on Works for Graduate Training Links of Central South University” .



## 六、课程设置与学分要求

课程类别	学分要求	课程类别	学分要求
公共学位课	5	学科基础课	4
专业课	2	选修课	2
学术交流与研讨	4	培养环节	4
补修课	0		
总学分	21		
学分说明	The course credits should be no less than 13. The credits of Academic Exchange and Discussion as well as training courses should be no less than 8.		

类别	课程编号	课程（环节）名称	学时	学分	开课学期	说明
公共学位课	10000003A01	中国概况	32	2	春秋季	Compulsory
公共学位课	11000003A01	汉语	64	3	秋季	Compulsory
学术交流与研讨	99000003F02	学术交流与研讨（博士生）		4	春秋季	Compulsory
选修课	46081103C02	多智能体系统与应用	32	2	秋季	No less than 1 or choose course from other discipline (more than 1)
专业课	46081104C01	复杂系统控制	32	2	秋季	No less than 1

专业课	46081104C0 2	先进运动控制	32	2	秋季	No less than 1
学科基础课	46081101B0 2	智能优化及其应用	32	2	秋季	No less than 2, the third one is compulsory if not study before
学科基础课	46081101C0 1	先进机器人学	32	2	秋季	No less than 2, the third one is compulsory if not study before
学科基础课	46081103B0 2	论文写作与学术规范.	32	2	春秋季	No less than 2, the third one is compulsory if not study before
培养环节	01	博士生资格考试		1		
培养环节	02	开题报告		1		
培养环节	03	中期考核		1		
培养环节	99000003F0 8	社会实践		1		

## 七、学术研讨与学术交流

Academic Exchange and Discussion is compulsory for all doctoral students, and require 4 credits.

Through multi-channel, multi-form and diversified academic discussion and academic exchange activities, we will create a strong academic and cultural atmosphere, lead the forefront, stimulate interest, and expand knowledge span and academic vision. For the “Academic Exchange and Discussion”, the specific requirements are as follows. (1) 2 credits will be given to those students, who attend an international academic conference and do presentation. (2) 1 credit will be given to those students, who attend conference organized in China and do presentation. (3) 1 credit will be given to those students, who report in other “Double First-Class” initiative university. (4) Each student must submit two papers to the Academic Annual Conference organized by School of Automation. The accepted papers will be counted as 1 credit. 1 credit will be given to those students, who do presentation in the conference, and another 1 credit will be given to those who are recommended to be excellent candidates in the Academic Annual Conference. (5) 1 credit will be given to those students, who attend academic reports 20 times.

## 八、博士生资格考试

Doctoral candidates should take part in the qualification examination, before making their dissertation proposal to determine their research topic and after completing the course credits requirements. Examination consists of written and oral examinations, and will be carried out at the third semester. Details are given as follows:

- (1) Social behavior, moral and scientific attitude;
- (2) The implementation of individual training plan and curriculum learning grade;
- (3) The basic theories, professional knowledge, modern science and technology knowledge and skills;
- (4) The understanding of the disciplines, the dynamics and progress of the forefront research in related fields at national and international levels.
- (5) The quality of scientific research, innovation and development potential.

The management of doctoral candidates who fail the qualification examination will be in accordance with “The Regulations on Graduate Student Status Management of Central South University” and “The Regulations on Works for Graduate Training Links of Central South University”.

## 九、学位论文开题报告

Under the guidance of supervisors, graduates should determine the research direction of their dissertations in the first semester, make a public topic selection report and determine research topics on the basis of consulting a large number of references. Doctoral students should read more than 120 research papers, of which more than 50% should be written in foreign language. The opening report shall be completed before the end of the fourth semester after the admission of doctoral students. Thesis topics should be based on the forefront of the discipline, and can make innovative achievements in theory or technology, which has great practical value or potential value. For those who fail to pass the first topic selection report, the students will have a second chance to give an opening report. However, the time interval between the two reports shall not be less than 6 months. The topic selection report of doctoral students shall be held in public within the discipline. Graduate students fill in the online report on the topic selection of graduate thesis of Central South University on the “Graduate Education Management Information System”. After the topic selection report is reviewed and approved, it will be submitted to the Graduate Management Office for

archival purposeThe details shall be implemented in accordance with “The Regulations on Works for Graduate Training Links of Central South University”, “The Detailed Rules for the Implementation of the Graduate’ s Thesis Proposal of School of Automation” and “The Measures and Appraisal of Dissertation for Doctoral Candidates of School of Automation” .

## 十、中期考核

All doctoral students must take part in the mid-term assessment. The basic conditions for the mid-term assessment are to complete the course study and obtain the corresponding credits, to open the thesis and to make certain progress in research. The mid-term assessment shall be completed one year after passing the opening of the dissertation and before the end of the sixth semester. The time interval between passing the mid-term assessment of the dissertation and the defense of the dissertation shall be at least one year. For details and assessment methods, please refer to “The Regulations on Works for Graduate Training Links of Central South University” .

## 十一、科研训练、专业实践和社会实践

The doctoral students of this discipline must complete the practical teaching task arranged by the school or participate in social practice. The university encourages postgraduates to use their professional cultural knowledge and skills to carry out social practice in science and technology, management, law and other aspects, explore or solve the technical or management problems in the social and economic development, so as to continuously improve their innovative practice ability. See “The Measures for the Administration of Social Practice Credits of Postgraduates of Central South University” for specific assessment methods.

## 十二、学年总结与考核

A comprehensive summary, evaluation and assessment will be carried out at the end of each academic year, including social performance, course scores, and academic achievements. The examination results will be used to adjust the scholarships and bursaries. Students who fail in the examination will be required to quit the doctoral program.

### 十三、学位论文工作

(1) Requirements on Academic Papers The requirements on academic achievement must be in accordance with the Degree Awarding Standard of the Control Science and Engineering, Central South University and other relevant documents.

(2) Dissertation Requirements The dissertation of graduate students shall be written in Chinese or English. Under the guidance of the supervisor, the dissertation shall be completed independently by the graduate students themselves.

The time for the graduate students to engage in the thesis work shall not be less than 2 years. The thesis should be carefully written according to the uniform format of the University's dissertation. The thesis must be correct in viewpoint, clear in order, reliable in argument, full in argumentation, rigorous in reasoning, logical in logic and smooth in writing. The thesis should show that the graduate students have reached the requirements of training objectives. Thesis pre defense will be conducted after the thesis is written as required. For those who pass the pre defense, the academic degree Office of the



University shall organize the thesis to be submitted for review. Only those who pass the review can conduct thesis defense. The writing of dissertation should be in accordance with the standard for writing postgraduate dissertation of Central South University. The inspection and assessment of dissertation work mainly includes the progress of postgraduate thesis work, the existing problems and the gap with the expected objectives, and puts forward solutions or requirements for the existing problems. (3) Dissertation Review, Defense and Degree-granting Graduate students who have completed the required credits, pass all the assessment, complete the dissertation review according to the specified procedures of the school and secondary training units, and can apply for dissertation defense with the consent of the supervisor and the review of the college. The full-time graduate students who have passed the oral defense of their dissertations are allowed to graduate and are issued with graduation certificates. Graduates who have passed the oral defense of their dissertations shall apply to the degree evaluation subcommittee of the secondary training unit where they work. After being examined by the degree evaluation subcommittee and submitted

to the degree evaluation committee of the University for discussion and approval, they can be awarded a degree and issued a degree certificate.

#### 十四、毕业论文工作

(1) Requirements on Academic Papers The requirements on academic achievement must be in accordance with the Degree Awarding Standard of the Control Science and Engineering, Central South University and other relevant documents.

(2) Dissertation Requirements The dissertation of graduate students shall be written in Chinese or English. Under the guidance of the supervisor, the dissertation shall be completed independently by the graduate students themselves. The time for the graduate students to engage in the thesis work shall not be less than 2 years. The thesis should be carefully written according to the uniform format of the University's dissertation. The thesis must be correct in viewpoint, clear in order, reliable in argument, full in argumentation, rigorous in reasoning, logical in logic and smooth in writing. The thesis should show that the graduate students have reached the requirements of training

objectives. Thesis pre defense will be conducted after the thesis is written as required. For those who pass the pre defense, the academic degree Office of the University shall organize the thesis to be submitted for review. Only those who pass the review can conduct thesis defense. The writing of dissertation should be in accordance with the standard for writing postgraduate dissertation of Central South University. The inspection and assessment of dissertation work mainly includes the progress of postgraduate thesis work, the existing problems and the gap with the expected objectives, and puts forward solutions or requirements for the existing problems. (3) Dissertation Review, Defense and Degree-granting Graduate students who have completed the required credits, pass all the assessment, complete the dissertation review according to the specified procedures of the school and secondary training units, and can apply for dissertation defense with the consent of the supervisor and the review of the college. The full-time graduate students who have passed the oral defense of their dissertations are allowed to graduate and are issued with graduation certificates. Graduates who have passed the oral defense of their dissertations shall apply to the

degree evaluation subcommittee of the secondary training unit where they work. After being examined by the degree evaluation subcommittee and submitted to the degree evaluation committee of the University for discussion and approval, they can be awarded a degree and issued a degree certificate.

附：修订专家名单

桂卫华、阳春华、王雅琳、徐德刚、陈晓方、蒋朝辉、王勇、黄科科等。