Instructive Cultivation Plan for the Program of Automation

(Grade 2020)

Course code: 080801

1. Orientation

In accordance with the strategic requirements of "Made in China 2025" and the needs of national economic development, this program bases on Shanghai and faces to the whole nation to cultivate high-level applied engineering and technical talents in intelligent manufacturing-related industrial fields, especially in the robotics industry, who are able to engage in system analysis and design, application research and development, system operation and integration, technical management and service of automation engineering, and have the potential for sustainable development.

2. Cultivation Objectives

2.1. General Objective

This program aims to train all-round field engineering talents, who have solid knowledge of mathematics and natural sciences, basic engineering knowledge, fine humanistic literacy and professional ethics; master basic knowledge of engineering technology such as automatic control, computer applications, intelligent systems, robots, and information technology; have application and innovation ability; are able to work in the front line of industrial production, especially in the field of robot application; engage in system analysis and design, application research and development, system operation and integration, technical management and service of automation engineering.

2.2. Value

The programs aims to train applied engineering talents who are able to adapt to social development by following the spirit of craftsmanship. Through university-enterprise cooperation and curriculum teaching, the students' professionalism of being rigorous, dedicated and responsible are developed, and their sense of social responsibility, teamwork spirit, lifelong learning as well as application innovation spirit are elevated.

2.3. Objectives students must achieve five years after graduation:

1) Master the natural science knowledge, engineering science knowledge, engineering technology knowledge and engineering environment knowledge required in automation and related fields;

2) Be able to use automation expertise, technology and skills to analyze and solve automation engineering problems related to professional positions, obtain the ability to propose solutions according to engineering needs, and have their own thinking on social, environmental factors and relevant policies and regulations to improve professional ability to design, develop and debug automation systems;

3) Have good team organization, communication and coordination skills, and be able to undertake, organize or participate in engineering problems in automation related fields as a team member or person in charge;

4) Have humanities and social science literacy, professional ethics, sense of social responsibility, global vision and sense of innovation in career and professional activities;

5) Obtain the ability of lifelong learning, be able to learn advanced manufacturing technology at home and abroad through self-learning, familiar with the current situation and development trend of automation engineering at home and abroad, be familiar with industry regulations and standards,

and continuously improve their own quality and ability to adapt to professional and social development.

3. Requirement for Graduation

The automation program expands the core competence and quality expression of the 12 graduation requirements based on the talent training positioning of our school in accordance with the 12 graduation requirements of the General Standards of the China Engineering Education Professional Certification Association. The index points of each graduation requirement are broken down as follows:

3.1: Ability to acquire and apply engineering knowledge: be able to apply basic principles of mathematics, natural sciences, engineering foundations and professional knowledge to abstract complex engineering problems in automation into mathematics and physics models, select appropriate models to describe, and analyze and solve the models.

1-1: master natural science knowledge such as mathematics and physics;

1-2: use mathematics, natural sciences, engineering foundations and professional knowledge to solve complex engineering problems appropriately;

1-3: use mathematics, natural sciences, engineering foundations and professional knowledge for calculation and analysis of engineering problems;

1-4: abstract complex engineering problems into mathematical and physical models, select appropriate models for description, make inference solutions and necessary corrections to the models, and understand their limitations.

3.2: Problem analysis ability: be able to apply the basic principles of mathematics, natural science and engineering science to identify, express, and analyze complex automation engineering application problems through literature research and obtain effective conclusions.

2-1: be able to use professional knowledge to reason, analyze, identify and judge the key links and parameters of complex automation engineering application problems;

2-2: be able to recognize that there are multiple solutions to complex automation engineering application problems, and be able to find effective solutions to engineering problems through literature research and analysis;

2-3: be able to model and analyze automation engineering problems and obtain effective conclusions based on mathematics, natural sciences and engineering sciences.

3.3: Ability to innovate design/development solutions: be able to design solutions for users' complex automation needs, design systems, units (components) or process flows that meet specific needs, and be able to reflect the sense of innovation in the design process, and always consider social, health, safety, legal, cultural and environmental factors.

3-1: Master the basic methods of automation engineering design, and be able to analyze complex automation engineering problems, propose design goals, and determine solutions;

3-2: Be able to formulate solutions based on the characteristics of users' complex automation needs, and can design systems, units or technological processes that meet specific needs;

3-3: Be able to comprehensively consider social, health, safety, legal, ethical, cultural and environmental factors in the design to reflect a certain sense of innovation.

3-4: Be able to present the design results in the form of design reports, engineering drawings or objects.

3.4: Scientific research ability: Be able to study complex automation engineering application problems based on scientific principles and by using scientific methods, including designing experiments, analyzing and interpreting data, and obtaining reasonable and effective conclusions through information synthesis.

4-1: Be able to apply the knowledge learned to formulate feasible experimental plans for related problems in automation engineering;

4-2: Be able to construct an experimental system or process according to the experimental plan, and be able to conduct experiments;

4-3: Be able to correctly analyze and interpret experimental data/results, and obtain reasonable and effective conclusions through information synthesis.

3.5: Ability to use modern tools: Be able to develop, select and use appropriate technologies, resources, modern engineering tools and information technology tools for complex automation engineering application problems, including the prediction and simulation of complex automation engineering application problems, and can understand its limitations.

5-1: Understand the status and development trend of automation engineering, and be able to grasp and use modern engineering technology, methods, tools or equipment in practice;

5-2: Be able to predict and simulate complex automation engineering application problems by using appropriate modern engineering tools, and understand the working principles and limitations of the modern tools used;

5-3: Master the sources and acquisition methods of important documents in the field of automation engineering.

3.6: Ability to analyze and evaluate the relationship between engineering and society: be able to conduct reasonable analysis and evaluation on the impact of professional engineering practices and complex engineering problem solutions on society health, safety, law and culture based on the relevant background knowledge of automation, and understand the responsibility.

6-1: Master the technical standards, intellectual property rights, industrial policies, laws and regulations related to automation;

6-2: Be able to conduct reasonable analysis based on professional knowledge and standards in terms of social, health, safety, legal and cultural influences, and evaluate solutions to complex automation engineering problems;

6-3: Be able to correctly understand the social, safety and legal responsibilities that automation engineers should bear in engineering practices.

3.7: Ability to understand and evaluate the environment and sustainable development: be able to understand and evaluate the impact of complex automation engineering application processes on the environment and sustainable development of society.

7-1: Be able to understand national and local policies, laws and regulations on environmental and social sustainable development;

7-2: Be able to correctly learn about and understand the impact of engineering practice aimed at automation engineering problems on the environment and the sustainable development of society.

3.8: Abide by professional standards: have humanities and social science literacy and a sense of social responsibility, be able to understand and abide by engineering professional ethics and standards in engineering practices, and can undertake responsibilities correctly.

8-1: Have humanities and social science literacy, understand the social responsibilities that should be undertaken, and be willing to serve the society;

8-2: Understand the professional nature and responsibilities of automation engineers, have legal awareness and consciously abide by professional ethics and norms in automation engineering practices.

3.9: Ability to assume individual and team roles: Be able to assume the roles of individuals, team members and leaders in a multidisciplinary team.

9-1: Have basic interpersonal and communication skills, and be able to correctly understand the role and significance of team strength and wisdom on complex engineering problems;

9-2: Be able to understand the meaning of each role in a multidisciplinary team for the goals of the entire team, and be able to play a role in a multidisciplinary team.

3.10: Ability to effectively communicate and exchange: be able to effectively communicate and exchange with industry colleagues and the public on complex automation engineering application issues, including reports and design manuscripts, presentations, clear expressions or response instructions. Have a certain international perspective, and be able to communicate and exchange under a cross-cultural context.

10-1: Be able to express one's thoughts orally or in writing, and effectively communicate and exchange with industry colleagues and the public on complex automation engineering issues;

10-2: Master at least one foreign language, be able to read the foreign literature of the major, and be able to use technical language to communicate and exchange in a cross-cultural context.

3.11: Ability to manage engineering projects: understand and master the principles of automation engineering project management and economic decision-making methods, and be able to apply them in a multidisciplinary environment.

11-1: Understand and master the important economic and management factors involved in automation engineering activities;

11-2: Be able to apply engineering management and economic decision-making knowledge in a multidisciplinary environment.

3.12: Have the consciousness and ability of lifelong learning: Have the consciousness of independent learning and lifelong learning, and be able to continuously learn and adapt to development.

12-1: Be able to correctly understand the necessity of lifelong learning, and have the consciousness of independent learning and lifelong learning;

12-2: Be able to learn independently according to personal or professional development needs, and have the ability to adapt to the development of society and automation engineering technology.

4. Schooling System

Four years

5. Length of Study

Flexible study period, generally four years, the minimum length of flexibility is not less than three years, the longest not more than six years.

6. Requirements for Graduation and Degree Conferring

Students of this program must complete the minimum credits required for each category of courses and complete all the content specified in extracurricular class according to the requirements of the instructional training plan, and the total credits must reach 154 credits for graduation; those who meet the requirements for bachelor's degree can be conferred bachelor degree in engineering.

7. Discipline

Control Science and Engineering, Electrical Engineering, Computer Science and Technology.

8. Core courses

8.1. Level 1 project (robot operation and maintenance, design and integrated application)

As the main line of the first-level engineering training program, the robot project runs through six semesters from the first grade to the fourth grade. The training is divided into several stages. In the initial stage, students will learn the use of the robot development platform, mainly master the use of control modules and sensors, learn to program robot control strategies by C language, and complete the assembly of specific functional robots through the combination of software and hardware. On this basis, it will guide students to participate in various competitions. Through competition projects, students will establish the concept of engineering projects and cultivate the sense of innovation. Through the collaborative work of the competition team, students' communication skills and teamwork spirit will be cultivated. Through the summary and speech defense after the competition, students' speech ability and report writing ability can be exercised. Through this stage of training, students will be clear about the follow-up professional foundation and professional courses.

In the intermediate and advanced stages, as students gradually learn professional basics and professional courses, the project will instruct students to design and produce various robotic systems by themselves, and use their self-made systems to complete various competition projects and various scientific innovation projects at all levels. The difficulty of design and production tasks will gradually increase, and students' ability to integrate theory with practice and comprehensive practice will be significantly improved, so that the students will gradually obtain the ability to independently design and produce electronic and electrical systems.

8.2. Level 2 project (electronic design)

The electronic design project organizes teaching and practical activities in the unit of curriculum group, including: electrical and electronic technology, electronic technology practice, engineering technology training, electronic technology and other main courses. Students will be able to use the knowledge and skills of these courses to solve specific problems in engineering practice related to the course group, so that theoretical teaching and engineering practice are closely integrated and mutually supported, and students' professional ability, communication ability, team spirit and leadership ability are trained.

This project is based on the test content of the electronic circuit installation and commissioning module of the electrician (level 4) vocational qualification certificate issued by the Shanghai Municipal Human Resources and Social Security Bureau, and will train students in the basic skills of electronic technology. The main contents include: (1) Application of basic electronic components: test and analysis of transient process characteristics of amplifying circuit composed of resistance, capacitance and inductance, bridge oscillation circuit; (2) Application of thyristor: characteristics test and analysis of thyristor pulse trigger circuit, thyristor dimming circuit, and

thyristor delay circuit; (3) Design and manufacture of voltage regulator circuit: transistor voltage regulator circuit, W78 series, W317 series voltage regulator chip application. (4) characteristic test and analysis of transistors and diode circuits (signal amplifying circuit, power amplifying circuit, level shifting circuit).

Students can work in groups, usually a group includes 3 to 4 people; students can also train and operate individually. After completing this module and basic training on electrical wiring, electrical troubleshooting, and PLC, students can participate in the electrician (level 4) vocational qualification certificate examination of the Shanghai Human Resources and Social Security Bureau. Those who pass the examination can obtain a nationally recognized vocational qualification certificate.

8.3. Embedded system application practice (second-level project)

This project is an engineering training course, which takes common problems in the field of detection and automation engineering as the learning object, and trains students to skillfully apply embedded system knowledge to solve problems. By designing hardware and software, this project uses ARM microprocessor for programming development to realize the input and output of GPIO port, timing and interrupt application, conversion of voltage and temperature analog quantity to digital quantity and detection, transmission of digital quantity to analog quantity and output drive. Students work in groups, usually 3 to 4 students are a group. Through the study of this course, students should exercise their ability to design system schemes, office software editing ability, the ability to use various electronic modules, C language programming ability and language expression ability for function demonstration. The teaching objective of this course is to closely integrate theoretical teaching and engineering practice and make them support each other, train students' professional ability, communication ability and team spirit; focus on cultivating students with strong practical application ability and innovation ability.

8.4. Electrical wiring practice, electrical troubleshooting practice, PLC basic training

The above three items are based on the test contents of the electrical control circuit installation and commissioning module, the electrical control circuit fault analysis and troubleshooting module, the sensor and PLC control circuit installation programming and commissioning module of the electrician (level 4) professional qualification certificate of Shanghai Human Resources and Social Security Bureau Based, and takes the common electrical control and PLC application engineering problems in the automation field as the background to train students to apply electrical control and PLC knowledge to solve problems. The contents include: (1) Design and installation of electrical control circuit: design and installation of hydraulic control machine tool sliding table movement electrical control circuit, two-speed motor automatic control circuit, three-phase asynchronous motor double chain forward and reverse start energy consumption braking control circuit, power delay Y/△ start control circuit of asynchronous motor with DC energy consumption brake, Y/△ start control circuit of asynchronous motor with DC energy consumption brake and power-off delay, asynchronous motor step-down start reverse brake control circuit, asynchronous motor autotransformer decompression start control circuit, bridge rectifier reversible energy consumption braking control circuit, winding type AC asynchronous motor automatic start control circuit, as well as design of electrical wiring, in order to achieve the required functions; (2) electrical control circuit fault analysis and elimination: M7130 surface grinder electrical control circuit fault analysis and elimination, C6150 lathe electrical control circuit fault analysis and elimination, Z3040 radial drilling machine electrical control circuit fault analysis and elimination; (3) Sensor and PLC control circuit installation, basic instruction programming and commissioning: PLC realization Y/△ start of AC asynchronous motor, PLC realization positive and negative rotation of AC asynchronous motor, PLC realization automatic control of water tower water level, PLC realization automatic control of colored lights flashing, PLC realization automatic control of transmission belt motor, PLC realization control of the quiz answering device of the quiz, PLC realization automatic control of the feeding device of the heating furnace, PLC realization automatic control of the drilling power head, and PLC realization automatic control of opening and closing of warehouse door.

Students can study in groups, usually a group consists of 3 to 4 students; they can also train and operate individually. After students have completed the study of electrical wiring, electrical troubleshooting, PLC basic training and second-level projects (electronic design), they can participate in the electrician (level four) vocational qualification certificate examination organized by Shanghai Human Resources and Social Security Bureau. Those who pass the examination can obtain nationally recognized professional qualification certificate.

8.5. Level 2 project (Electrical control and PLC integration)

Electrical control and PLC foundation organizes teaching and practical activities based on the course group, including: modern engineering drawing, automatic mechanical design, electrical CAD, electrical control and PLC, sensor technology, electrical wiring practice, electrical troubleshooting practice, PLC basic training, etc. The knowledge and skills of these courses are used to solve specific problems in engineering practice related to the course group, so that theoretical teaching and engineering practice are closely integrated and mutually supported, and students' professional ability, communication ability, team spirit and leadership ability are trained.

This project is based on the test content of the relay electrical control circuit surveying and troubleshooting module and the PLC control system installation and adjustment module of the electrician (level three) professional qualification certificate of Shanghai Human Resources and Social Security Bureau, and is under the background of common electrical control and PLC application engineering problems in the automation field. This project will train the students to be proficient in applying electrical control and PLC knowledge to solve problems. The contents include: (1) PLC control system installation, stepping numerical control instruction programming and commissioning: transport trolley control PLC control, mechanical sliding table control PLC control, manipulator control PLC control, mixing tank control PLC control, traffic light control PLC control, spray fountain control PLC control, conveyor belt control PLC control, sewage treatment control PLC control, piece counting control PLC control, bottle picking control PLC control. Students need to design a PLC control system that conforms to industrial reality. (2) Relay control circuit surveying and troubleshooting: X62W universal milling machine control circuit surveying and troubleshooting, T68 horizontal boring machine control circuit surveying and troubleshooting, 20/5t bridge crane control circuit surveying and troubleshooting.

Students can study in groups, usually a group of 3 to 4 students; or can also train and operate individually. After completing the second-level project (electrical control and PLC integration) and the second-level project (motion control system integration), students can participate in the examination for electrician (level three) vocational qualification certificate organized by Shanghai Human Resources and Social Security Bureau, and those passed the examination can obtain a nationally recognized professional qualification certificate.

8.6. Level 2 Project (Comprehensive Project of Motion Control System)

The comprehensive project of motion control system organizes teaching and practical activities in the unit of course group, including main courses such as automatic control principle, system modeling and simulation, power electronics technology, motor drive foundation, and motion control system. The knowledge and skills of these main courses are used to solve specific problems in engineering practice related to the course group, so that theoretical teaching and engineering practice are closely integrated and mutually supported, and students' professional ability, communication ability, team spirit and leadership ability will be trained.

This project is based on the test content of the AC and DC drive system assembly and adjustment module and the application electronic circuit assembly and maintenance module in the electrician (level 3) professional qualification certificate examination of Shanghai Human Resources and Social Security Bureau, and trains the students to apply the knowledge of automatic control principles, power electronics, and electric motors to control technology is under the background of common control systems engineering application in the industrial automation field. The contents include: (1) AC and DC drive system installation and commissioning: including test and drawing

of speed and current double closed loop irreversible DC speed control and system adjustment characteristics static characteristic, test and drawing of logic non-circular current reversible DC speed control and system adjustment characteristic and static characteristic, AC inverter fixed frequency control mode commissioning and system operation curve mapping, AC inverter speed control mode commissioning and system operation curve mapping;

(2) application electronic circuit installation and maintenance: including installation and commission of triangle wave generator, sine wave square wave triangle wave generator, digital timer, single pulse control shift register, shift register ring counter, three-phase half-wave controllable rectifier circuit with inductive load, three-phase half-wave controllable rectifier circuit with common anode connection, three-phase fully-controlled bridge rectifier circuit with inductive load, three-phase half-controlled bridge rectifier circuit with freewheeling diode, and the double reverse star controllable rectifier circuit, as well as the waveform mapping.

Students can study in groups, usually a group of 3 to 4 people; or can also train and operate individually. After completing the second-level project (electrical control and PLC integration) and the second-level project (motion control system integration), students can participate in the electrician (level three) vocational qualification certificate examination of Shanghai Human Resources and Social Security Bureau, and can obtain a nationally recognized professional qualification certificate after passing the examination.

8.7. Level 2 Project (Comprehensive project of Process Control System)

The control system comprehensive project organizes teaching and practice activities in the unit of curriculum group, including main courses such as automatic control principle, automatic instrument and system, process control technology, computer control technology and other main courses. The knowledge and skills of these main courses are used to solve specific problems in engineering practice related to the course group, so that theoretical teaching and engineering practice are closely integrated and mutually supported, and students' professional ability, communication ability, team spirit and leadership ability are trained.

This project takes the common control system engineering application problems in the industrial automation field as the background to trains students to learn how to apply automatic control principles, power electronics, signal and system knowledge flexibly to control technology. The contents include: (1) design of water tank level control algorithm: taking the laboratory water tank as the object, design a water tank level control algorithm, and realize specific control on the experimental system to verify the control effect of the algorithm; (2) design of water tank temperature control algorithm: taking the laboratory water tank as the object, design a water tank water temperature fuzzy control algorithm, and realize specific control on the experimental system to test the control effect of the algorithm; students study in groups for training, usually a group consists of 3 to 4 students, and finally the student will conduct an exam presentation alone.

8.8. Introduction to Engineering

The purpose of the "Introduction to Engineering" course is as follows: by introducing the basic features and concepts of engineering, solutions to general engineering problems, economic characteristics of engineering projects, and tasks and responsibilities faced by engineers, this course will allow students to understand the engineering issues involved in related engineering programs and stimulate their interest to learn about engineering programs, and clear motivation for study. Through the study of this course, students can put forward some ideas and thoughts to solve engineering problems when facing general engineering problems; can cultivate their interpersonal communication and teamwork spirit; and lay a certain foundation for them to learn follow-up professional courses and smoothly carry out and complete the first, second and third level projects.

8.9. Modern Engineering Drawing I

"Modern Engineering Drawing I" is a main professional basic course for engineering programs of

higher technical schools. The task of this course is to cultivate students' ability to draw and read engineering drawings. Through the study of this course, students will be able to master the basic theory of projection method, master the projection diagram expression method of mechanical parts, and be able to correctly and proficiently use common drawing tools and instruments and computers to draw engineering drawings, so as to lay a certain practical foundation for facilitating subsequent professional courses and smooth progress at all levels.

8.10. Electric Circuit

This course is an important professional basic course for automation programs. The main content of this course is to analyze electromagnetic phenomena in circuits, study the basic laws of circuits and circuit analysis methods. This course will provide basic circuit theory and electric circuit analysis for subsequent professional basic courses. This course mainly teaches linear circuits, sinusoidal circuits, DC circuits, transformers, RLC circuit transition processes, motors, electrical control circuits, and safe use of electricity, etc. After completing the study of this course, students should meet the following basic requirements: first, master the concepts and basic laws of ideal components, circuit models, reference directions, and related reference directions; second, understand the constraints of voltage and current in lumped parameter circuits; third, proficiency in the analysis of resistance circuits, the time domain analysis of linear dynamic circuits, the analysis of sinusoidal steady-state circuits, the steady-state analysis of non-sinusoidal periodic current circuits, and the analysis methods of nonlinear circuits. The purpose of this course is to cultivate students' solid circuit analysis ability and the ability to solve practical problems through the study of basic circuit theory and circuit analysis methods, so as to lay a solid foundation for future practical work.

8.11. Analog Electronic Technology

This course is one of the main professional basic courses for automation program, and is a highly applied course that closely combines theory and practice. This course mainly teaches the principles and application technology of diodes, triodes, amplifier circuits, power amplifiers, oscillator circuits, analog integrated circuits and functional module circuits. After completing the study of this course, students should meet the following basic requirements: first, master the basic working principles, characteristics and main parameters of commonly used semiconductor devices (diodes, triodes, field effect tubes, linear integrated circuits), and be able to select and use these devices reasonably; second, master the principle, structure, performance and application of basic circuits (common-emitter amplifier circuit, common-collection amplifier circuit, complementary symmetrical power amplifier circuit, negative feedback amplifier circuit, integrated operational amplifier circuit); third, familiar with the structure, working principle, performance and application of the application circuit (sine signal producing circuit, non-sinusoidal signal generating circuit, first-order active filter circuit, rectifier filter circuit, etc.); fourth, master certain analysis and calculation ability, including mastering the diagram analysis method of single-stage amplifier circuit, master the analysis method of the triode simplified H-parameter micro-change equivalent circuit, understand the analysis method of the multi-stage amplifier circuit, master the method of identifying the type of negative feedback amplifier circuit and estimating the method of voltage amplification of the deep negative feedback circuit, etc.; fifth, grasp the basic application skills, including the primary grasp of the general laws of reading and analyzing analog circuit schematics, primary grasp of the design calculation steps and methods of general analog unit circuits, and the ability to consult electronic device manuals and reasonably select devices. Through the study of this course, students will be able to acquire the basic theories and basic knowledge necessary for analog electronic technology. Furthermore, this course focuses on cultivating students’ skills and improving their ability to analyze problems, solve problems, and apply practical applications, thus laying the necessary foundation for learning subsequent courses and practical applications,.

8.12. Digital Electronic Technology

This course is an important professional technical basic course for automation programs. The

digital electronic technology is the main direction of electronic technology development in the future. This course mainly teaches design examples of number systems, combinational logic, flip-flops, A/D, D/A, medium and large-scale integrated circuits, and various digital logic circuits. Through the study of this course, students will be able to master the basic concepts, basic principles and basic analysis and design methods of digital electronic technology, familiar with typical basic unit circuits and digital system reading diagrams, can perform simple digital circuit installation and commissioning, and obtain the ability to further study electronics technology and professional courses.

8.13. Fundamentals of Motor and Drive

This course mainly teaches the main structure, basic principles and working characteristics of AC and DC motors and transformers; the mechanical characteristics, starting, braking and speed regulation of AC and DC electric drive systems; the selection of electric motors for electric drive systems.

8.14. Principles of Automatic Control

This course is a basic engineering course that studies the basic concepts, basic principles, and basic analysis and design methods of automatic control systems. The main contents of this course include three aspects: automatic control system modeling, automatic control system analysis, and automatic control system design (correction). Through the study of this course, students will master the classic control theory and methods of analyzing and synthesizing SISO automatic control system, be able to analyze and design the control system, and be able to perform computer-aided analysis and design of the control system with the support of MATLAB and Simulink, thus laying a solid foundation for further in-depth study and research on other control theories and control system design in the future.

8.15. Fundamentals of Control Program Design

This course mainly teaches the basic concepts and basic techniques of programming, and cultivates students' logical thoughts and engineering design thinking. Taking C language as an example, this course requires students to learn to draw simple program flowcharts, be more proficient in the grammar and semantics, master the basic methods of structured program design, master some common program design skills, master the top-down gradually refined program design technology, cultivate good program design habits and styles, thus enabling students to master the basic process of computer programming operations and the basic methods of eliminating grammatical and semantic errors.

8.16. Signals and Systems

This course mainly teaches the analysis of time domain, frequency domain and complex frequency domain of continuous and discrete signals and systems, and time domain analysis and transformation domain analysis of signals while passing through linear time invariant systems. Through the study of this course, students will have a firm grasp of the basic principles and basic methods of time domain and transform domain analysis of signals and systems, understand the mathematical concepts, physical concepts and engineering concepts of Fourier transform, Laplace transform, and Z transform and master the basic theories and methods of using signals and systems to analyze and solve practical problems, thus laying a solid foundation for further study of follow-up courses such as digital signal processing, communication principles, automatic control principles, and computer control technology.

8.17. Motion Control System

This course teaches motion control composed of DC motors, AC motors, servo motors, and stepping motors, including single closed-loop speed control systems, double-loop speed control systems, reversible speed control systems, DC pulse width speed control systems, basic

composition and control law of AC speed control system, static and dynamic performance analysis and engineering design method.

8.18. Process Control

This course mainly teaches the basic concepts of process control, process channel signal processing and regulating instruments, actuators, dynamic characteristics of process control objects, single loop and complex control systems, and computer process control systems.

8.19. Computer Control Technology

This course mainly teaches the composition, application methods and common models of computer control systems, input and output channels and interface technology. Through the study of this course, students will master the principles and applications of basic computer control algorithms, understand the general structure of control software, and initially grasp the use of an industrial control configuration software method.

8.20. Sensor Technology

This course is a follow-up course of self-control principles, detection technology and other courses. The content of electrical courses is integrated and used flexibly in this course. Through the study of this course, students will have a complete understanding of the process control instruments necessary for the automatic regulation system, that is, the function, principle and composition of the regulator, distributed control system and regulating valve, and will understand the basic working principles of various detection instruments and process control instruments, understand the composition, adjustment methods and applications of process control systems. This course is an important professional course for training automation talents.

9. Practical Training

Basic engineering training B, second-level project (embedded system application), automatic machinery (solikworks) design, first-level project (robot operation and maintenance, design and integrated application) I, second-level project (electronic design), second-level project (embedded system design), PLC basic training, electrical wiring training, electrical troubleshooting training, control system CAD, secondary project (motion control system integration), secondary project (electric control and PLC integration), automated production line training, level one project (robot operation and maintenance, design and integrated application) II, level one project (robot operation and maintenance, design and integrated application) III, second classroom, automation (CDIO) graduation internship and graduation design (thesis).

10. Course Structure and Course Hours (excluding extracurricular class)

Category	Total Credit	%	Total Course Hours	Theory Learning	Practical Training
General Education	52.5	34	992	928	64
Basic Course	28.5	19	456	376	80
Professional Course	27.5	18	440	385	55
Practical Training	34.5	22	976	0	976
General Course	10	7	160	160	0
Total	153	100	3024	1849	1175
Theory : Practice(%)	61:39				

11. Teaching schedule (1)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hour	Theory Learning	Practical Training	Semester
General Education	required	School of Marxism	b1080001	Basic principles of Marxism	test	3	48	42	6	spring 1
	required	School of Marxism	b1080006	Outline of Chinese Modern History	non-test	3	48	42	6	autumn 1
	required	School of Marxism	b1080003	Morality and Laws	non-test	3	48	42	6	spring 1
	required	School of Marxism	b1080004	Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics I	test	3	48	42	6	autumn 2
	required	School of Marxism	b1080007	Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics II	test	2	32	28	4	spring 2
	required	School of Marxism	-----	Situation and Policy (module 1～4)	non-test	2	32	28	4	autumn 1～ spring 2
	required	School of Marxism	B1080008	Labor Education A	non-test	0.5	16	16		autumn 2
	required	College of Arts and Sciences	b1020080+	Advanced Mathematics A1	test	4	64	64		autumn 1
	required	College of Arts and Sciences	b1020081+	Advanced Mathematics A2	test	4	64	64		spring 1
	required	College of Arts and Sciences	b1020012	Linear algebra	test	2	32	32		autumn 2
	required	College of Arts and Sciences	b1020013	Probability Theory and Mathematical Statistics	test	2	32	32		autumn 2
	required	College of Engineering College of Arts and Sciences	b1020023	Complex variable function and integral transformation	test	2	32	32		autumn 2
	required	College of Arts	b1020062	College Physics A(module 1)	test	3	48	48		spring 1

		and Sciences								
	required	College of Arts and Sciences	b1020065	College Physics B	test	2	32	32		autumn 2
	required	College of Arts and Sciences	b1020066	College Physics C	non-test	1	32		32	spring 1
	required	College of Arts and Sciences	b1020018	College Chinese	non-test	2	32	32		spring 1
	required	Others	b1110003	Military skills	non-test	0.5	2W			autumn 1
	required	College of Arts and Sciences	b1110002	Military theory	non-test	0.5	32	32		autumn 2
	required	College of Arts and Sciences	b1020003	General English III	test	3	48	48		autumn 1
	required	College of Arts and Sciences	b1020004	General English IV	test	3	48	48		spring 1
	required	College of Arts and Sciences	b1020005	General Academic English A	test	2	32	32		autumn 2
	required	College of Arts and Sciences	---	English development	non-test	2	32	32		spring 2
	required	Department of Physical Education	-----	Physical Education I～VI	non-test	3	160	160		autumn 1～ autumn 4
Total (General Education)						**52.5**	**992**	**928**	**64**	
General Course	selective	Others	b0-----	Social Science and Humanities Literacy (2 credits) Public Art (2 credits)	non-test	4	64	64		Autumn, spring
	required	College of Engineering	b2013127	Computer and Information Technology Fundamentals	non-test	2	32	32		autumn 1
	required	College of Engineering	b2013024	Scientific paper writing and document retrieval	non-test	2	32	32		autumn 1
	required	College of Engineering	b2012236	Engineering ethics	non-test	2	32	32		autumn 2
Subtotal (general course)						**10**	**160**	**160**		

11. Teaching schedule (2)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hour	Theory Learning	Practical Training	Semester
Basic professional courses	required	College of Engineering	b2012237zd	Introduction to Engineering	non-test	1.5	24	24	0	autumn 1
	required	College of Engineering	b2011398zd	Modern Engineering Drawing I	test	2	32	26	6	spring 1
	required	Engineering Training Center	b2011031zd	Electric Circuit	test	4	64	52	12	autumn 2
	required	Engineering Training Center	b2012060zd	Analog electronics	test	3	48	36	12	spring 2
	required	Engineering Training Center	b2012099zd	Digital Electronic Technology	test	3	48	36	12	spring 2
	required	College of Engineering	b2011408zd	Fundamentals of motor and drive	test	2.5	40	34	6	spring 2
	required	College of Engineering	b2011267zd	Fundamentals of control programming	test	3	48	36	12	spring 2
	required	College of Engineering	b2011257zd	Single-chip microcomputer technology basis	test	2	32	28	4	spring 2
	required	College of Engineering	b2011409zd	Principle of Automatic Control	test	3.5	56	48	8	autumn 3
	required	College of Engineering	b2011273zd	Microcomputer Principle and Interface Technology	test	2	32	24	8	autumn 3
	required	College of Engineering	b2012128zd	Signals and Systems	test	2	32	32	0	autumn 3
	Subtotal (Basic professional courses)					28.5	456	376	80	
Professional courses	required	College of Engineering	b2011410zd	Power electronic converter technology	test	2.5	40	34	6	autumn 3
	required	College of Engineering	b2011411zd	Electrical control and PLC	test	3	48	39	9	autumn 3
	required	College of Engineering	b2011344zd	Motion Control System	test	2.5	40	34	6	spring 3

	required	College of Engineering	b2011399zd	Industrial Robot Technology	non-test	2	32	32		spring 3
	required	College of Engineering	b2011400zd	Sensor Technology	non-test	2	32	26	6	spring 3
	required	College of Engineering	b2011401zd	Industrial Control Configuration Software Technology	non-test	1.5	24	16	8	spring 3
	required	College of Engineering	b2011402zd	Intelligent control	test	2	32	28	4	spring 3
	required	College of Engineering	b2011301zd	Control system modeling and simulation	non-test	2	32	28	4	autumn 4
	required	College of Engineering	b2011044zd	Factory power supply and distribution	test	2	32	28	4	autumn 4
	required	College of Engineering	b2011083zd	Computer control technology	test	2	32	28	4	autumn 4
	Subtotal (required professional courses)					21.5	344	293	51	
	★Module, Selective, 6 credits	Module A	b2011412zd	Process control technology	non-test	2	32	26	6	spring 3
			b2011275zd	Modern control theory	test	2	32	28	4	spring 3
			b2011166zd	Automation instrumentation and measurement	non-test	2	32	28	4	autumn 4
			b2011403zd	Intelligent optimization calculation	non-test	2	32	28	4	autumn 4
		Module B	b2011404zd	C# PROGRAMMING	non-test	2	32	20	12	spring 3
			b2011405zd	Machine vision	non-test	2	32	26	4	spring 3
			b2011230zd	Virtual instrument technology	non-test	2	32	18	6	autumn 4
			b2011406zd	Android system development	non-test	2	32	16	16	autumn 4
		Module C	b2011041zd	Wind power technology	non-test	2	32	28	4	spring 3
			b2011039zd	Electrical part of wind power plant	non-test	2	32	28	4	spring 3
			b2011064zd	Photovoltaic power generation technology	non-test	2	32	26	6	spring 3
			b2011040zd	Wind turbine monitoring and control	non-test	2	32	26	6	autumn 4
			b2011407zd	Power System Analysis	non-test	2	32	26	4	autumn 4
	Subtotal (modular professional courses)					6	96	92	4	
Subtotal (professional courses)						27.5	440	385	55	

11. Teaching schedule (3)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hour	Theory Learning	Practical Training	Semester
Practical Training	required	Engineering Training Center	b4090002zd	Basic engineering training B	non-test	2	48		48	summer 1
	required	College of Engineering	b4011265zd	Automated machinery (solikworks) design	non-test	2	48		48	autumn 2
	required	College of Engineering	b4011266zd	Embedded System Design (Level 2 project)	non-test	2	48		48	summer 2
	required	College of Engineering	b4011267zd	Robot operation and maintenance, design and integrated application I (Level 1 project)	non-test	1.5	36		24	summer 2、autumn 3
	required	College of Engineering	b4011268zd	Electronic design(Level 2 project)	non-test	1.5	36		36	summer 2、autumn 3
	required	College of Engineering	b4011269zd	PLC BASIC TRAINING	non-test	1.5	36		36	autumn 3
	required	College of Engineering	b4011270zd	Electrical wiring practice	non-test	1.5	36		36	autumn 3
	required	College of Engineering	b4011271zd	Electrical troubleshooting practice	non-test	1.5	36		36	autumn 3
	required	College of Engineering	b4011272zd	Automated production line training	non-test	2	48		48	summer 3
	required	College of Engineering	b4011273zd	Electrical control and PLC integration (Level 2 project)	non-test	3.5	84		96	spring 3
	required	College of Engineering	b4011274zd	Control System CAD (Bilingual)	non-test	1	24		24	spring 3
	required	College of Engineering	b4011275zd	Electrical CAD	non-test	1	24		24	spring 3
	required	College of Engineering	b4011276zd	Robot operation and maintenance, design and integrated application II (Level 1 project)	non-test	1.5	36		36	summer 3

	required	College of Engineering	b4011277zd	Motion Control System integration(Level 2 project)	non-test	3.5	84		96	summer 3
	required	College of Engineering	b4011339	Labor Education B	non-test	0.5	16		16	spring 3
	required	College of Engineering	b4011253zd	Automation Program (CDIO) Graduation Practice and Graduation Design (Thesis)	non-test	6	288		288	spring 4
	Subtotal (required practice courses)					32	928		928	
	★Professional module selective 2 credits	module A	b4000021zd	Automation Professional Innovation and Entrepreneurship Course _ Process Control System Integration(Level 2 project)	non-test	2	48		48	autumn 4
		module B	b4011278zd	Automation Professional Innovation and Entrepreneurship Course _ Robot operation and maintenance, design and integrated application III(Level 1 project)	non-test	2	48		48	autumn 4
		module C	b4011279zd	Automation Professional Innovation and Entrepreneurship Course _ New energy power generation system integration(Level 2 project)	non-test	2	48		48	autumn 4
	Subtotal (practice module)					2	48		48	
Total (professional practice)						34.5	976		976	
Extracurricular Class	required	Others	b5110001	Extracurricular Class	non-test	1	-	-	-	autumn , spring , summer
Total						154	3024	1849	1175	

★1. Guidance for professional module courses and practical module courses:

Professional courses are divided into modules according to different ability requirements. Students must selective one of the modules and meet the required credits for that module. Professional practice modules must be selected according to the corresponding professional course modules.

1. Module A: Automation instrumentation and measurement, Modern control theory, Process control technology, Intelligent optimization calculation
2. Module B: C# PROGRAMMING (integration of theory and practice), Virtual instrument technology (integration of theory and practice), Machine vision (integration of theory and practice), Android system development (integration of theory and practice)
3. Module C: Wind power technology, Electrical part of wind power plant, Photovoltaic power generation technology, Wind turbine monitoring and control, Power System Analysis

2. Professional Certificates can be gained after learning following courses:

Students who have passed PLC BASIC TRAINING, Electrical wiring practice, Electrical troubleshooting practice, Level 2 project (Electronic design) courses, can participate in the professional qualification certificate assessment related to this program: Electrician (Level 4) certificate.

Students who have passed the Level 2 project (Electrical control and PLC integration) and Level 2 project (Motion Control System integration) courses can participate in the professional qualification certificate assessment related to this program: electrician (level three) certificate.

Students who have passed the Fundamentals of control programming course can participate in the professional qualification certificate assessment related to the program: Level 2 C programming (Shanghai or the whole country) certificate.

Students who have passed the Electrical CAD course can participate in the professional qualification certificate assessment related to this program: Electrical CAD (Intermediate) Certificate.

Students who have passed Single-chip microcomputer technology basis, Microcomputer Principle and Interface Technology, Level 2 project (Embedded System Design) courses can participate in the professional qualification certificate assessment related to this program: Embedded System Development (Level 3) certificate.

Students who have obtained electrical engineering (Level 4) can apply for exemption from PLC BASIC TRAINING, Electrical wiring practice, Electrical troubleshooting practice, and Level 2 project (Electronic design) courses and obtain corresponding credits.

Students who have obtained electrical engineering (Level 3) can apply for exemption from Level 2 project (Electrical control and PLC integration) and Level 2 project (Motion Control System integration) courses and obtain corresponding credits.

Students who have obtained Level 2 C programming certificate (Shanghai or National Certificate) can apply for exemption from Fundamentals of control programming courses and obtain corresponding credits.

Students who have obtained Electrical CAD (Intermediate) can apply for the exemption of Electrical CAD courses and obtain corresponding credits.

Students who have obtained embedded system development certificate (level three) can apply for exemption from single-chip microcomputer technology basis, Microcomputer Principle and Interface Technology, and Level 2 project (Embedded System Design) courses and obtain corresponding credits.

12. Prerequisite for Course Study

No.	Course name	Prerequisite Course	No.	Course name	Prerequisite Course
1	Electric Circuit	Calculus A1	16	Level 2 project(Motion Control System integration)	Modern control theory
		Calculus A2			Motion Control System
		College Physics			Power electronic converter technology
2	Analog electronics	College Physics	17	Electrical wiring practice	Electrical control and PLC
		Electric Circuit	18	Electrical troubleshooting practice	Electrical control and PLC
3	Digital Electronic Technology	College Physics			Electrical wiring practice
		Electric Circuit	19	PLC BASIC TRAINING	Electrical control and PLC
		Analog electronics	20	Level 2 project(Electrical control and PLC integration)	Electrical control and PLC
4	Fundamentals of Motor Drive	College Physics			PLC BASIC TRAINING
		Electric Circuit			Electrical troubleshooting practice
5	Principle of Automatic Control	Calculus A2	21	Electrical CAD	Electrical control and PLC
		Electric Circuit			Electrical control and PLC integration
		Fundamentals of Motor Drive	22	Sensor Technology	Embedded System Design
6	Single-chip microcomputer technology basis	Electric Circuit			Electronic design
		Analog electronics			Mathematical Statistics and Probability Theory
		Digital Electronic Technology	23	Computer control technology	Microcomputer Principle and Interface Technology
7	Fundamentals of control programming	Digital Electronic Technology			C# PROGRAMMING
		Single-chip microcomputer technology basis	24	Industrial Control Configuration Software Technology	Electrical control and PLC
8	Microcomputer Principle and Interface Technology	Single-chip microcomputer technology basis			Computer control technology
		Embedded System Design	25	Industrial Robot Technology	Motion Control System
					Sensor Technology
9	Signals and Systems	Calculus A2	26	Factory power supply and distribution	Electrical control and PLC
		Electric Circuit	27	Intelligent control	Principle of Automatic Control
		Principle of Automatic Control			Control system modeling and simulation
10	Power electronic converter technology	Electric Circuit	28	Intelligent optimization algorithm	Intelligent control
		Analog electronics			System modeling and simulation
		Digital Electronic Technology	29	Automation instrumentation and measurement	Sensor Technology
11	Electrical control and PLC	Fundamentals of Motor Drive			Single-chip microcomputer technology basis
		Embedded System Design	30	Process control technology	Principle of Automatic Control
					Automation instrumentation and measurement
12	Motion Control System	Principle of Automatic Control			Industrial Control Configuration Software Technology
		Fundamentals of Motor Drive	31	C# PROGRAMMING	Fundamentals of control programming
		Power electronic converter technology			Microcomputer Principle and Interface Technology
13	Control System CAD	Principle of Automatic Control	32	Virtual instrument technology	Sensor Technology
14	Modern control theory	Linear algebra			Single-chip microcomputer technology basis
		Principle of Automatic Control	33	Machine vision	Sensor Technology
15	Control system modeling and simulation	Control System CAD			C# PROGRAMMING
		Motion Control System	34	Android system development	Fundamentals of control programming
		Modern control principle			C# PROGRAMMING

35	Wind power technology	Fundamentals of Motor Drive	42	Automated production line training	Electrical control and PLC
		Motion Control System			Industrial Control Configuration Software Technology
		Power electronic converter technology			Electrical CAD
			43	Automated mechanical design	Modern Engineering Drawing I
36	Electrical part of wind power plant	Electrical control and PLC			Automated production line training
		Wind power technology	44	Process control system integration	Process control technology
37	Photovoltaic power generation technology	College Physics			Computer control technology
		Electric Circuit			Industrial Control Configuration Software Technology
		Power electronic converter technology	45	New energy power generation system integration	Photovoltaic power generation technology
38	Wind turbine monitoring and control	Wind power technology			Factory power supply and distribution
		Electrical part of wind power plant	46	Robot operation and maintenance, design and integrated application I	Electronic design
		Industrial Control Configuration Software Technology			Embedded System Design
39	Power System Analysis	Electric Circuit	47	Robot operation and maintenance, design and integrated application II	Motion Control System integration
		Fundamentals of Motor Drive			Industrial Robot Technology
40	Embedded System Design	Single-chip microcomputer technology basis			Robot operation and maintenance, design and integrated application I
		Fundamentals of control programming			
41	Electronic design	Electric Circuit	48	Robot operation and maintenance, design and integrated application III	Machine vision
		Analog electronics			Robot operation and maintenance, design and integrated application II
		Digital Electronic Technology			

13. Extracurricular Class

Through taking extracurricular classes, students are encouraged to take part in academic lectures, social practice activities, campus cultural and sports activities, innovative and entrepreneurial activities, voluntary activities, etc. to improve their social adaptability and enhance the competitiveness in the job market. Details are specified in Students' Manual.