Instructive Cultivation Plan for the Program of Computer Science and Technology (Outstanding Engineer)

(Grade 2020)

Course code: 080901

1. Orientation

This program aims at cultivating senior engineering application-oriented technical talents who have good engineering literacy, master the basic principles, basic knowledge, professional skills and methods of computer science and technology, be able to engage in product demand analysis, design and development testing, operation and maintenance, and management and service, etc. in computer-related fields and other industries that require information construction, especially the embedded field.

2. Cultivation Objectives

2.1. General cultivation objective

This program cultivates senior engineering application-oriented technical talents who are comprehensively developed on morality, intelligence, physical fitness, and beauty, meet the needs of economic construction and social development in Shanghai and the "Yangtze River Delta", have high comprehensive quality, strong practical ability, pioneering spirit and the ability to solve practical problems in the field of computer applications, and face to production, management and service.

2.2. Objective of value guidance

Taking the spirit of model workers as the value orientation, this program embeds the engineer values and engineering ethics in teaching in the implementation process of education and teaching, so as to cultivate students' healthy value recognition, good professional habits, and a focused and responsible work attitude.

2.3. Objectives students must achieve five years after graduation:

- Be able to successfully carry out works related to computer software and hardware systems, especially work related to embedded systems;
- Have good project management and presentation skills, and be able to understand and solve practical problems related to computer software and hardware systems under the social background;
- Be able to communicate effectively with domestic and foreign counterparts and customers, adapt to an independent and team work environment, have good professional training and moral standards;
- Be able to adapt to career development through lifelong learning, and be competitive in the workplace in computer-related fields.

3. Requirement for Graduation

3.1. Engineering knowledge: be able to use mathematics, natural sciences, engineering foundations and professional knowledge to solve complex engineering problems in the computer field.

1-1: be able to use mathematics, natural science, engineering foundation and professional knowledge necessary for computer programs to express computer engineering problems;

1-2: be able to establish mathematical models and program design for specific objects;

1-3: be able to use relevant knowledge and mathematical models to deduct and analyze solutions to complex computer engineering problems;

1-4: be able to use relevant knowledge and mathematical model methods for the comparison and synthesis of computer engineering solutions.

3.2. Problem analysis: Be able to apply basic principles of mathematics, natural sciences, and engineering sciences to identify, express, and analyze complex engineering problems in the computer field through literature research, and can obtain effective conclusions.

2-1: be able to use the basic principles of mathematics, natural sciences, and engineering mathematics to identify and judge the key links of complex engineering problems in the field of computer applications, and determine the main technical indicators;

2-2: be able to correctly express complex engineering problems based on relevant scientific principles and mathematical model methods, construct a prototype system based on calculation principles, and analyze its rationality;

2-3: be able to recognize that there are many options for solving the problem, and can seek alternative and backup solutions through literature research;

2-4: be able to use the basic principles of computer science and specialized application fields, and use literature research to analyze the influencing factors of the process and obtain effective conclusions.

3.3. Design/development solutions: Be able to design solutions to complex engineering problems in the computer field, develop systems, modules or processes that meet specific needs, and reflect the sense of innovation in the design and development links, while taking into account social, health, safety, legal, cultural and environmental factors.

3-1: Master the basic design/development methods and technologies of the entire cycle and process of engineering design and product development, and understand various factors that affect design objectives and technical solutions;

3-2: Be able to complete the design of computer subsystems for specific needs;

3-3: Be able to design computer systems and reflect the sense of innovation in the design;

3-4: Be able to consider restrictive factors such as safety, health, law, culture and environment in the design process;

3-5: Be able to design and implement pre-sales and after-sales services of computer hardware and software systems.

3.4. Research: Be able to study complex engineering problems in the computer field based on scientific principles and using scientific methods, including designing experiments, analyzing and interpreting data, and obtaining reasonable and effective conclusions through information synthesis.

4-1: Based on the scientific principles of computer science and technology and related disciplines and through literature research or related methods, be able to research and analyze solutions to complex computer engineering problems;

4-2: According to the characteristics of the object, be able to choose a research route and design a computer experiment plan;

4-3: Be able to construct a computer experiment system according to the computer experiment plan, and carry out experiments safely and collect experiment data correctly;

4-4: Be able to analyze and interpret the results of computer experiments, and obtain reasonable and effective conclusions through information synthesis.

3.5. Using modern tools: be able to develop, select and use appropriate technologies, resources, modern engineering tools and information technology tools for complex engineering problems in the computer field, including the prediction and simulation of complex engineering problems, and can understand their limitations.

5-1: understand the principles and methods of using modern instruments, information technology tools, engineering tools, and simulation software commonly used in computer science, and can understand the limitations;

5-2: be able to select and use appropriate instruments, information resources, engineering tools and professional simulation software to analyze, calculate and design complex computer engineering problems;

5-3: be able to develop or select modern tools that meet specific needs for specific objects, simulate and predict professional problems, and be able to analyze the limitations.

3.6. Engineering and society: Be able to conduct reasonable analysis based on engineering-related background knowledge, evaluate the impact of computer engineering practices and complex engineering problem solutions on society, health, safety, law and culture, and understand the responsibilities that should be undertaken.

6-1: Understand the technical standard system, intellectual property rights, industrial policies, laws and regulations in related fields of computer science, and understand the impact of different social cultures on computer engineering activities;

6-2: Be able to analyze and evaluate the impact of computer professional engineering practices on society, health, safety, law, and culture, as well as the impact of these constraints on the implementation of computer engineering projects, and understand the responsibilities that should be undertaken

3.7. Environment and sustainable development: Be able to understand and evaluate the impact of engineering practice for complex engineering problems in the field of computer applications on the sustainable development of environment and society.

7-1: Be able to understand and evaluate the dialectical relationship between solutions to computer complex engineering problems, professional engineering practices, and sustainable development of the environment and society;

7-2: Be able to consider the factor of harmonious and sustainable development of the environment and society in the solution process of complex computer engineering problems.

3.8. 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 computer engineering practices, and always perform the responsibilities.

8-1: Have correct values, understand the relationship between individuals and society, and understand China's national conditions;

8-2: Understand the engineering professional ethics and norms of honesty, fairness and integrity, and be able to consciously abide by them in the practice of computer engineering;

8-3: Understand the social responsibility undertaken by computer engineers for the safety, health and well-being of the public, as well as environmental protection, and be able to consciously fulfill their responsibilities in engineering practices.

3.9. Individuals and teams: Have the awareness and ability of teamwork, and be able to assume the roles of individuals, team members and leaders in a multi-disciplinary team.

9-1: Have good physical fitness and a clear individual awareness, be able to communicate effectively with members of other disciplines, and work together;

9-2: Be able to find one's position in the team, smoothly integrate into a team, and work independently or cooperatively;

9-3: Be able to organize, coordinate and direct the team to carry out work.

3.10. Communication: Be able to effectively communicate and exchange with industry peers and the public on complex engineering issues in the field of computer engineering, including writing reports and design manuscripts, making statements, expressing clearly or responding to instructions, and have a certain international perspective, be able to communicate and exchange under a cultural context.

10-1: Be able to effectively express one's thoughts and wishes through oral, manuscripts, charts, etc. on computer professional issues, respond to queries, and understand the differences in communication with industry peers and the public;

10-2: Understand the international development trends and research hotspots in the field of computer science, understand and respect the differences and diversity of different cultures in the world;

10-3: Have the oral and written expression skills for cross-cultural communication, and be able to communicate and exchange on computer professional issues under a cross-cultural context.

3.11. Project management: understand and master the engineering management and economic decision-making methods in the field of computer engineering, and can apply them in a multi-disciplinary environment.

11-1: Understand the economic decision-making methods of computer engineering projects, master the design process and management methods of computer projects and products, be able to analyze the economic and social benefits of computer engineering projects in a multidisciplinary environment, and be able to analyze and judge their comprehensive benefits;

11-2: Understand the cost structure of computer engineering and product cycle and process, and understand the engineering management and economic decision-making issues involved;

11-3: Be able to use engineering management and economic decision-making methods in the process of designing and developing computer engineering project solutions in a multidisciplinary environment (including simulation environment).

3.12. Lifelong learning: have the consciousness of independent learning and lifelong learning, and have the ability to continuously learn and adapt to development.

12-1: Under the background of social development, be able to recognize the necessity of autonomy and lifelong learning;

12-2: Be able to learn independently, including the ability to understand technical issues, the ability to summarize and ask questions, etc.

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 157 credits for graduation; those who meet the requirements for bachelor's degree can be conferred bachelor degree in engineering.

7. Disciplines

Computer science and Technology

8. Core Courses

1. Discrete Mathematics

This course mainly teaches the structure and relationship of discrete quantities, including set theory, algebraic structure, mathematical logic, graph theory, etc. This course is the core of basic theories in computer science. The purpose of this course is to improve students' abstract thinking ability, modeling ability and logical reasoning ability in the professional field.

2. Foundation of Programming Design

This course mainly teaches the basic concepts and basic techniques of programming. Taking C language as an example, this course requires students to be more proficient in its grammar and semantics and master the basic methods of structured programming. The knowledge points of this course include data types, control structures, functions, arrays, files, operating mechanisms and preliminary debugging. Through the study of this course, students will master some common programming design skills, master programming techniques of top-down refinement, cultivate good programming habits and styles, and be able to master the basic process of computer programming operations, as well as the basic methods of eliminating grammatical and semantic errors.

3. Fundamentals of Computer Circuits

This course mainly teaches related knowledge of circuit analysis, analog electronic technology and digital electronic technology used in computer systems. The main contents include: circuit analysis foundation, semiconductor device foundation, basic amplifier circuit, operational amplifier and signal processing circuit, digital logic foundation, gate circuit, combinational logic circuit, flip-flop, sequential logic circuit, memory and programmable logic device, etc. While introducing basic knowledge and basic theories, this course also gives appropriate consideration to skill training, new devices and new knowledge.

4. Data structure

This course mainly teaches data construction methods and algorithms for operating these data structures. The focus is on various typical data structures and their storage structures, related algorithms and basic spatiotemporal analysis, including linear tables and their derived structures (stacks, queues, strings, Multidimensional arrays), trees and graphs, and typical algorithms for search and internal sorting. The focus is to enable students to further master more standardized algorithm design skills and improve their thinking skills on the basis of their existing programming capabilities.

5. Principles of Computer Composition

This course focuses on the basic composition and working principle of the single CPU computer hardware system of the von Neumann architecture, and systematically describes the internal structure, functional characteristics, working principles, interaction methods and basic design methods of the computer hardware system and its functional components. At the same time, through the combination of classroom teaching, course experiment and course practice, students can systematically understand the organization structure and working principle of computer hardware system, and master the basic analysis methods of computer hardware system. The main contents of this course include: overview of computer composition, machine representation of values, calculation methods and calculation components, storage systems, instruction systems, central processing units, input and output systems, buses, etc.

6. Principle and Application of Microprocessor

This course mainly teaches the internal structure principle of embedded microprocessor, assembly language and C language programming technology, interrupt system and on-chip peripheral application technology, interface extension and programming technology, embedded system design and engineering implementation technology, etc. Taking the STM32 microprocessor as the carrier, this course shows students the design and implementation methods of intelligent electronic systems in detail and focuses on cultivating students' engineering design ideas and practical skills, which fully embodies the teaching concept of combining theory with practice.

7. Introduction to Database System

This course mainly teaches the basic concepts and basic theories of database systems. The main contents include: the progress of data management, the composition of database systems, three basic data models (focusing on relational models), and the standard design of relational models (including functional dependencies, paradigms, multi-value dependence, joint dependence, representation theory), relational database systems (focus on relational database theory, SQL and query optimization), database security and integrity constraints, database design, database technology development trends, etc.

8. Computer networks

This course mainly teaches basic types of network, network classification, network topology, Ethernet technology, access network technology, network layer protocol, transport layer protocol, domain name resolution system, dynamic host address configuration protocol, World Wide Web, mail system, etc. The focus of this course is to enable students to understand the specific processes and corresponding processing mechanisms of data packets transmitted at each layer of the network.

9. Practical Training

Intensive practice in school:

Program design and practice, data structure course design, microprocessor application course design

Distributed practice in school: integrated training of embedded application system design (1), integrated training of embedded application system design (2), and comprehensive training of innovative project design, innovative project design and enterprise demand research.

Enterprise concentrated practice:

System integrated design based on enterprise project (1), system integrated design based on enterprise project (2), graduation internship and graduation design (thesis) of computer science and technology, etc.

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

Category	Total Credit	%	Total Course Hours	Theory Learning	Practical Training
Public Course	50.5	33	960	896	64
Basic Course	31	19	496	413	83
Professional Course	18	12	288	225	63
Practical Training	46.5	30	1120	0	1120
General Course	10	6	160	160	0
Total	156	100	3024	1694	1130
Theory : Practice(%)	56:44				

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	b1080003	Ideological and moral cultivation and legal foundation	non-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	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 Arts and Sciences	b1020018	College Chinese	non-test	2	32	32		autumn 1
	Required	College of Arts and Sciences	b1020063	College Physics A(Module 2)	test	3	48	48		spring 1
	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	autumn 2

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hour	Theory Learning	Practical Training	Semester
	Required	Department of Physical Education	-----	Physical Education I～VI	non-test	3	160	160		autumn 1～ autumn 4
	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
Total (General Education)						**50.5**	**960**	**896**	**64**	
General Course	Required	College of Engineering	b2013024jk	Scientific paper writing and document retrieval	non-test	2	32	32		spring 3
	Selective	Others	b0-----	Social Science and Humanities Literacy (4 credits) Natural Science and Technological Innovation (2 credits) Public Art (2 credits)	non-test	8	128	128		autumn ， spring
Subtotal (general course)						**10**	**160**	**160**	**0**	

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	b2012018jk	Foundation of Programming Design	test	4	64	40	24	autumn 1
	Required	College of Engineering	b2012178jk	Introduction to Computer Science and Technology	non-test	1	16	16		autumn 1
	Required	College of Engineering	b2012227jk	Data structure	test	3	48	48		spring 1
	Required	College of Engineering	b2012242jk	Fundamentals of Computer Circuits	test	4	64	48	16	spring 1
	Required	College of Engineering	b2012290jk	Principles of Computer Composition	test	4	64	48	16	autumn 2
	Required	College of Engineering	b2012088jk	Introduction to Database System	test	2	32	28	4	autumn 2
	Required	College of Arts and Sciences	b1020099jk	Discrete Mathematics	test	3	48	48		spring 2
	Required	College of Engineering	b2012120jk	Principle and Application of Microprocessor	test	4	64	56	8	spring 2
	Required	College of Engineering	b2012239jk	Operating system	test	3	48	39	9	autumn 3
	Required	College of Engineering	b2012045jk	Computer networks	test	3	48	42	6	autumn 3
Subtotal (Basic professional courses)						**31**	**496**	**413**	**83**	
Professional courses	Required	College of Engineering	b2012006jk	Java programming	non-test	2	32	20	12	spring 2
	Required	College of Engineering	b2012070jk	Introduction to Software Engineering	test	2	32	32		spring 2
	Required	College of Engineering	b2012106jk	Design and Analysis of Algorithms	test	3	48	32	16	autumn 3
	Required	College of Engineering	b2012043jk	Computer Architecture	non-test	3	48	42	6	autumn 3
	Required	College of Engineering	b2012015jk	Compilation principle	non-test	3	48	39	9	spring 3
	Required	College of Engineering	b2012241jk	Engineering ethics	non-test	1	16	16		spring 3

Subtotal (required professional courses)						**14**	**224**	**181**	**43**	
★Selective by module 4 credits	Module A	b2012291jk	Sensor and computer interface technology	non-test	2	32	24	8	spring 3
		b2012292jk	Measurement technology and equipment	non-test	2	32	24	8	spring 3
	Module B	b2012164jk	Fundamentals of IoT Technology	non-test	2	32	32		spring 3
		b2012204jk	Big data technology foundation	non-test	2	32	24	8	spring 3
	Module C	b2012293jk	Embedded Operating system application development	non-test	2	32	24	8	spring 3
		b2012294jk	Development technology of embedded software	non-test	2	32	24	8	spring 3
	Module D	b2012234jk	Web programming	non-test	2	32	24	8	spring 3
		b2011452jk	Software Testing Technology	non-test	2	32	20	12	spring 3
Subtotal (professional module courses)						**4**	**64**	**44**	**20**	
Subtotal (professional courses)						**18**	**288**	**225**	**63**	

11. Teaching schedule (3)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hour	Theory Learning	Practical Training	Semester
Vocational practice	Required	College of Engineering	b4012005jk	Programming design and practice	non-test	2	48		48	spring 1
	Required	College of Engineering	b4012172jk	Data structure course internship	non-test	3	72		72	summer 1
	Required	College of Engineering	b4012110jk	Microprocessor Application Course Design	non-test	2	48		48	summer 2
	Required	College of Engineering	b4012111jk	Embedded system design comprehensive training (1)	non-test	3	72		72	autumn 2
	Required	College of Engineering	b4012089jk	Embedded system design comprehensive training (2)	non-test	3	72		72	spring 2
	Required	College of Engineering	b4012173jk	Comprehensive training for innovation project design	non-test	3	72		72	autumn 3
	Required	College of Engineering	b4012174jk	Innovative project design and enterprise demand research	non-test	3	72		72	spring 3
	Required	College of Engineering	b4000013jk	Innovation and Entrepreneurship in Computer Science and Technology	non-test	2	48		48	spring 3
	Required	College of Engineering	b4012175jk	Comprehensive design based on enterprise projects (1)	non-test	4	96		96	autumn 4
	Required	College of Engineering	b4012176jk	Comprehensive design based on enterprise projects (2)	non-test	4	96		96	autumn 4
	Required	College of Engineering	b4012186	Labor Education B	non-test	0.5	16		16	spring 3
	Required	College of Engineering	b4012142jk	Graduation Practice and Graduation Design (Thesis) of Computer Science and Technology (Excellent)	non-test	13	312		312	spring 4
	Subtotal (required practice courses)					**42.5**	**1024**		**1024**	
	★Selective by program module 4 credits	Module A	b4012015jk	Electronic circuit CAD practice	non-test	2	48		48	summer 3
			b4012083jk	Intelligent detection project design	non-test	2	48		48	summer 3
		Module B	b4012086jk	Design of intelligent terminal application system item	non-test	2	48		48	summer 3
			b4012177jk	Big data technology practice	non-test	2	48		48	summer 3
		Module C	b4012055jk	Design of database and information system project	non-test	2	48		48	summer 3
			b4012179jk	Course design of development technology of	non-test	2	48		48	summer 3

				embedded software						
		Module D	b4012901jk	Practice of Software Testing Technology	non-test	2	48		48	summer 3
			b4012086jk	Design of intelligent terminal application system item	non-test	2	48		48	summer 3
	Subtotal (practice module)					**4**	**96**		**96**	
Subtotal (professional practice)						**46.25**	**1120**		**1120**	
Extracurricular Class	Required	Others	b5110001	Extracurricular Class	non-test	1	-	-	-	autumn, spring, summer
Total						**157**	**3024**	**1694**	**1130**	

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

Professional courses are divided into modules according to different ability requirements. Students must select 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: This module is aimed at the application and development of computer hardware systems, information detection, processing, and application technology;
2. Module B: This module is aimed at the technological direction of the Internet of Things and big data;
3. Module C: This module is aimed at the application and development of embedded systems.
4. Module D: This module is aimed at the development and testing of computer software systems.

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

Students who have participated in the Computer Software Competency Certification (CCF CSP) examination organized by the China Computer Society, and obtain certification scores meeting certain standards, can apply for exemptions from data structure course internship, data structure, design and analysis of algorithms, programming design and practice courses and obtain corresponding credits.

13. Prerequisite for Course Study

No.	Course name	Prerequisite Course	No.	Course name	Prerequisite Course
1	Data structure	Foundation of Programming Design	7	Principle and Application of Microprocessor	Foundation of Programming Design
		Programming design and practice			Data structure
		Discrete Mathematics			Fundamentals of Computer Circuits
					Principles of Computer Composition
2	Fundamentals of Computer Circuits	Advanced Mathematics A1	8	Computer networks	Foundation of Programming Design
					Data structure
					Principles of Computer Composition
3	Principles of Computer Composition	Fundamentals of Computer Circuits	9	Embedded system design comprehensive training (1)	Foundation of Programming Design
		Foundation of Programming Design			Data structure
4	Introduction to Database System	Foundation of Programming Design	10	Embedded system design comprehensive training (2)	Embedded system design comprehensive training (1)
		Data structure			
5	Operating system	Foundation of Programming Design	11	Comprehensive training for innovation project design	Embedded system design comprehensive training (1)
		Data structure			Embedded system design comprehensive training (2)
		Discrete Mathematics			
6	Introduction to Software Engineering	Foundation of Programming Design	12	Innovative project design and enterprise demand research	Comprehensive training for innovation project design
		Data structure			

14. 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.