Category	Item	Item Description	Guidance	Computers and	Digital representation	Basic structure of hardware and software	Algorithms and	Modeling and simulation	Data modeling and management	AI and data science	Information network	Information systems	Computer security	Information ethics	Academic ICT literacy
General Principles of Information	Information and meaning (information has meaning, changes the world, gives value and order there)	Meaning and value for life To be the basis for selected actions for living things to survive Individual selected actions are eliminated through trial and error, leading to the creation of a common social value Information and order Move the world and make it order by meaning action, regardless of physical power		communication	or mormation	and software	programming		management						
	Types of information (information in a broad sense / narrow sense / narrowest sense(inclusion relation))	Life information (source of meaning action, including tacit knowledge such as physical skills) information in a broad sense: all explicit / non-explicit information Not only DNA genetic information Social information (all information applicable to human society) Information in a narrow sense: life information specified by a symbol Not just information provided by mass media Machine information formation proproprocessed by machine) Information in the narrowest sense: Individual signs of social information Not only digital information of 0/1			Δ										
	Information and symbols (information consists of a set of symbols and the semantic content they represent)	- Similar symbols (patterns similar to semantic contents) - Analog signal - Image, imitation mimetic word etc Indicator symbol (pattern having semantic content and logical relation) - Toilet and emergency exit guide plate etc Symbol sign (pattern irrelevant to semantic content) - Digital signal etc Most language symbols etc.			Δ					0					
	Meaning interpretation of symbols (the way of meaning interpretation depends on the entity handling information)	Individual organisms including human beings (autonomous interpretation of signs) Self-compliant interpretation processing based on past experiences Intentional composition of the subjective world including the value and purpose of the individual Human social organization (community oriented meaning interpretation) Self-compliant interpretation based on past experience or practice Construction of mutually subjective worlds including community values and objectives by communication Electronic machines such as computers (other-directed and formal processing of signs) interpretation processing based on the instructed operation procedure and the format of the symbol Simulation of objective world. Simulation of human thought			Δ					0					
	Communication (a system that creates communication based on information)	Autonomous closed system (model of organisms including humans) Autopoietic systems Semi-autonomous provisional closed system (model of human social organization) Hierarchical autonomous communication systems A system in which humans and computers are complexly diversified Other-directed open systems (models of electronic machines such as computers) Allopoietic systems													
	Creation of social value (new options becomes available through information processing)	 Individually selected actions develop into a social common option through trial and error and survival competition New and valuable options are created 													
Information transformation and	Quantities of information Quantization (discretization), sampling	the amount of information in Shannon's terms, entropy Nyquist frequency Data companion area detailed and companion.			0 0										
transmission		Data compression, error detection and correction Common key encryption, public key encryption			J								0		
Information representation,		Character code, numerical expression · Array, tree, graph, set			0					0			-		
accumulation		Recursive data structure Type inspection,type inference								,					
and management	Database	· Data model							0						
g	Signal processing	WWW, structured document Filtering, noise reduction													
Information	0 1	Speech recognition, image recognition								0					
recognition and analysis	Machine learning	Supervised learning, unsupervised learning Neural network								0					
ļ	Data Mining	Regression analysis, clustering													
	Computation model	 Automata, formal language (Chomsky hierarchy), Turing machine, lambda calculus Stochastic computation, parallel computation, distributed computation Quantum computation 													
Computation	algorithm	Stochastic algorithm, parallel algorithm, distributed algorithm													
	Limitation of computation Computational efficiency	Computability, incompleteness theorem Computational complexity, hierarchy of computational complexity						0							
	Expression of computation	Computational complexity, hierarchy of computational complexity Programming language, formal semantics					0	U							
	Correctness of computation	Program logic, verification					Ö								

	Searching, sorting	Character string matching, sorting algorithm				0								
		• Binary tree,BDD,Game tree												
	Tree and graph algorithm	· Shortest path, network flow					0		0					
		· Network analysis												
		Matrix (inverse matrix, eigenvalue decomposition)					_							
	Numerical calculation	Integral, differential equation					0							
		· Error analysis												
		Mathematical model					_							
Algorithm	Simulation	Continuous simulation, discrete event simulation					0							
		· Computer graphics												
	Optimisation	Linear programming Dynamic programming					0							
	Optimisation	Dynamic programming Metaheuristics					U							
	Ctti1				1									
	Computational geometry	Triangulation, Voronoi diagram							_					
	Automatic reasoning	Resolution principle, model inspection							0					
	Natural language processing	Morphological analysis, phrase structure grammar												
		· Statistical natural language processing												
	Circuit element	Semi conductor, gate, VLSI												
	Digital circuit	Combination circuit, sequential circuit			0									
Computer		Operation circuit, control circuit, memory (main memory, cache)			_									
hardware		Micro architecture, control strategy												
	Computer architecture	Instruction set architecture			0									
		Parallel processing (instruction level parallelism, multi core, multi				1	1	1	1					1 1
—	Interface	processor, warehouse scale computing) Serial, parallel, network interfaces		1	 							1	1	
	Output device	Printer, display, actuator		1	 							1	1	
I/O device	Input device			 	 	 	 	 	 			 	 	\vdash
		Keyboard, pointing device, touch panel, sensor			 							 		\vdash
	Secondary storage	Magnetic device, optical device, semi conductor memory, HDD, SDD		1	 	1	1	1	1			1	1	
	0 :: :	Monolithic kernel, micro kernel, virtual machine			0	1	1	1	1	0				1
	Operating system	• Management of memory, process, device and file system				1	1	1	1	J				
	Middleware	Network (protocol stack, TCP/IP, distributed system, cloud computing) DBMS, transaction, network service, WWW		-	 	 	 	 	 	0		-	-	
Fundamental	madeware			-	 	 	 	 	 	U		1	-	
software		 Programming language (high/low level language, grammer, semantics, paradigm) 				1	1	1	1					
	Programming language and				0									
	language processor	 Language processor (lexical, syntactical or semantic analysis, optimization, code generation) 												
		Program execution (transator, compiler, interpreter, virtual machine)												
	Communication	Non-character information, verval information	0		1									
	Communication													
Process and		· Mechanical IT (publishment) · mechanical processing of character												
mechanisn for		information, media literacy, censorship, formation of journalism												
information	Media - technological and	Optical/electrical IT (video and audio) cultural enterprise, image												
creation and	cultural characteristics	production and manipulation, mediated community, speed and power												
transmission		· Electronic IT (internet etc.) · · language processing, recording, archiving,												
		database, digital communication, information governance and regulated society												
		society												
	Discussion, participation, digital	Misunderstanding and misreading, participation and exclusion, information												
Human	divide	gap												
characteristics	Observation, simulation, control	Limitation of observation and computation, scientific data and decision												
and social	and social decision making	making, communication related to science and technology, collective												
system	Ü	intelligence		-	 	 	 	 	 			1	-	
1	Information ethics and rules at	Freedom of expression and responsibility, intellectual property, information				1	1	1	1				Δ	
—	social organization	disclosure, informed consent, privacy, inside denunciation, accountability			 							 		
Economic system	Economic system and information	Production and control of product, information system supporting logistics, marketing, resource and disposal				1	1	1	1		0			
and information		marketing, resource and disposal Internal/external information, information management, public		 	 	 	 	 	 			 	 	
mormation	Organization management	communications, governance and government				1	1	1	1		Δ	Δ		
	Digital archive	Video, document, library		1	1	1	1	i e	1			1	1	
		· SNS culture		t	1	1	1	1	1			t	t	<u> </u>
		Digital book (digital textbook), digital newspaper				1	1	1	1					
IT-based culture		Digital book (digital textbook), digital newspaper Digital video				1	1	1	1	_				
	Digital culture and capital	Information retrieval and knowledge				1	1	1	1	0]
		· Digital TV				1	1	1	1]
		· Social capital, society, common				1	1	1	1					
Transition from	Human and value of modern					İ	İ	İ	İ					
modern society to	society	Modern society and IT, Modern human and IT				1	1	1	1					
post modern	Transition to post modern society	Newly required human ability, Development of more democratic society							0					
society	mansition to post modern society	utilizing IT							U					
		· Field observation (field work, ethnography, action research)												
	Requirement engineering	· Requirement definition, requirement elicitation, requirement				1	1	1	1					
		management	 		<u> </u>		L							
j	Systems engineering	System thinking, system design techniques, system development techniques,									0			
	Dyoremo engineering	system lifecycle, system architecture, design thinking)									O			
	Technology to describe	Various modeling techniques (structured analysis, data modeling, work flow,				<u> </u>	1	<u> </u>	<u> </u>					
	Technology to describe information system	state modeling, formal method) and diagrams (DFD, UML, BPMN,				1	1	1	1		0			
Technology for	ппогшаноп зувтеш	SysML)				1	1	1	1					j l
information		· Software design techniques (object oriented mode, domain oriented												
system	Software engineering	development), software lifecycle				1	1	1	1					
development		· Software architecture, pattern languages												

Page-control processors Page-control pro													
Transport review of the content of			Object oriented programming										
From the process of t		Programming	Test driven development (TDD)										
Section contents Section con													
Formation and advantage of the antiformation of the control of the			Software verification, software testing, ISO/IEC SQuaRE series										
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Law computer aroas, information heakage, computer virus, stc) Privaciple protection Characteristics of human Privaciple and deal plants Presently recognition mechanism of human, Law of Fitz Manual Privaciple and dealing Privaciple and dealin													
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Characteristics of human Characteristics of		Law									O	0	
Characteristics of human understanding the man error and design methodology for HCI HCI HUMAN COMPUTE OF HORSE AND ADDRESS A													
Principle and design understanding - Human error - Design information and the control of the con			Model Human Processor, recognition mechanism of human, Law of Fitzz										
Principle and design methodology for HC and the properties of elements of the properties of elements of the properties of elements of the properties of elements of the properties of elements of the properties of elements o		Characteristics of human	Direct manipulation										
Commission of the commission	Principle and	understanding											
User interface design Coper interface guadelines, usability, accessibility, a													
HUMAN computer interaction - 4-04 blyset understand, such interface, softer - 4-05 blyset understand of more ration, second processing, computation, data analysis - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to design and represent computation - Ability to develop and operate machine to handle information - Ability to develop and operate system organization and structure - Ability to understand and represent system organization and structure - Ability to understand and represent system organization and structure - Ability to understand and represent system organization and structure - Ability to understand and represent system organization and structure - Ability to understand general principles of information while beging rules in the society - Ability to understand general principles of information and to actively participate in the information selective - Ability to recognize importance and risk of information against individuals society - Ability to recognize importance and risk of information against individuals society - Ability to recognize importance and risk of information adaptation and abstraction - Ability to develop and solving - Creativity - Creativity - Creativity imagination - Information selice and perception of the society - Ability to discover and solving - Ability to develop and perception of the society - Ability to discover and solving - Ability to develop and perception of the society - Ability to develop and perception of the society - Ability to develop and perception of the society - Ability of computational perception of the society - Ability to develop and perception of the society - Ability to develop and perception of the society - Ability to develop and perception of the so		User interface design											
Human computer interaction Visualization Visualization Information of conversation, recovery from human error	HCI												
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Society and the society - Ability to utilize information while keeping rules in the society - Ability to utilize information while keeping rules in the society Creativity - Computational thinking - Communication - Commun					l			1					
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Creativity Creativity Creativity, imagination Creativity, imag								1				1	
Generic skill for IT student Communication		Creativity			t			1				1	
Generic skill for IT student		*					_						
IT student Communication Communication, presentation O Team work and leadership Cooperation, leadership, tolerance to stress		Logical/Computational thinking					0						
Communication Communication Presentation O Team work and leadership Cooperation, leadership, tolerance to stress Domain development, self Ability to learn independently		Problem discovery and solving	Ability to discover and solve problems, systematic thinking, critical thinking										
Domain development, self Ability to learn independently	11 Student	Communication	Communication, presentation										0
			Cooperation, leadership, tolerance to stress										
enlightenment - Ability to harmonize and/or correlate													
		enlightenment	Ability to harmonize and/or correlate										