

■ Information Technology Engineers Examination —————

Systems Architect Examination

(Level 4)

Syllabus

— Details of Knowledge and Skills Required for
the Information Technology Engineers Examination —

Version 4.1

The logo for the Information Technology Promotion Agency (IPA) of Japan, featuring the letters 'IPA' in a bold, red, stylized font.

INFORMATION-TECHNOLOGY PROMOTION AGENCY, JAPAN

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[Information System]

Major category	Minor category	Outline	Required knowledge	Required skills
I Contracts/Agreements				
Preparation of an RFP (Request For Proposal); preparation of a proposal; support for creating a project plan; etc.				
1 Preparation of an RFP (Request For Proposal)	1-1 Preparation of an RFP (Request For Proposal)	<p>As an acquirer, when presenting a supplier with a request for proposal, organize and document the following requirements for acquisition in terms of technology:</p> <ul style="list-style-type: none"> • System requirements • Scope • Instructions to bidders • List of systems, software products, or services • Contract conditions • Outsourcing management • Technical restrictions (e.g., actual environment) <p>When organizing the requirements, consider the acquirer's basic policy for procuring computerization resources.</p>	<ul style="list-style-type: none"> • Requirements with regard to the business, organization, and users • Requirements of safety, security, and other severity • Applicable standards • Contracts for outsourcing • Technical restrictions • How to proceed with a project • Acquirer's basic policy for procuring computerization resources • Risk investigation • Computerization models 	<ul style="list-style-type: none"> • Coordinating related in-house departments • Defining system requirements • Considering options for acquisition • Considering an acquisition plan • Documenting acceptance criteria • Selecting an appropriate solution for implementing a business model • Correctly selecting candidates to procure computerization resources from • Based on an RFP, correctly explaining acquirer's goal, scope, and procurement requirements to a supplier
2 Preparation of a Proposal	2-1 Preparation of a proposal	<p>As a supplier, in response to the acquirer's request for proposal, prepare a proposal and submit it upon coordinating related in-house departments.</p>	<ul style="list-style-type: none"> • Proposals • Requirements with regard to the business, organization, and users • Requirements of safety, security, and other severity • Applicable standards • Contracts for outsourcing • Technical restrictions • How to proceed with a project • Acquirer's basic policy for procuring computerization resources • Risk investigation • Computerization models • Cost estimate 	<ul style="list-style-type: none"> • Understanding requirements for the acquisition • Considering a solution that implements a business model • Changing how to proceed with a project in accordance with its characteristics • Coordinating related in-house departments • Negotiating with the acquirer • Understanding types of information that are entered and issued for specific business operations • Analyzing systems • Considering an entire system configuration based on business operations • Presenting system images in a comprehensible way
3 Support for Creating a Project Plan	3-1 Support for creating a project plan	<p>From the viewpoint of the entire system plan, support and advise about the following to the project manager who creates the project plan:</p> <ul style="list-style-type: none"> • What is needed for developing, operating, and maintaining a system, such as an organization, resources, work items, and a schedule • What is needed for outsourcing (when 	<ul style="list-style-type: none"> • Project plans • Labor laws and regulations • Outsourcing 	<ul style="list-style-type: none"> • Sufficiently communicating with project managers • Evaluating project plans in terms of system feasibility

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		<p>applicable), such as relevant work items, work scope, and schedule</p> <ul style="list-style-type: none"> • Specifications and conditions for procuring system products and vendors • Requirements of quality assurance 		
	3-2 Advice for the approval of the information system development project plan	<p>Perform the following in the approval process of the information system development project plan:</p> <ul style="list-style-type: none"> • Reply to questions from the person in charge of the department of information systems. • Reply to questions from the CIO (Chief Information Officer). 	<ul style="list-style-type: none"> • Approval process of a project plan 	<ul style="list-style-type: none"> • Understanding and replying to questions from the person who approves project plans
II Planning Determining the content of target business operations; analysis of the current system for the target business; studies of applicable information technologies; creation of a business model; organizing computerization functions and planning a systems architecture; clarification of basic policy regarding service level and quality; consideration of feasibility; defining the system selection policy; projection of costs and investment effect of the system; etc.				
4 Computerization Planning	4-1 Identification of basic requirements for computerization planning	<p>In creating a computerization plan, identify basic requirements of development, operations, maintenance, testing, migration, environment preparation, and quality. Also, based on a computerization initiative, identify basic policies (regarding such matters as goals, means, staff, period, delivery date, equipment, costs, work assignments, and responsibility assignments) that are prerequisites for computerization planning.</p>	<ul style="list-style-type: none"> • Computerization initiatives • Business operations • Notations related to business and information • System analysis techniques • Systems architectures, hardware, and software • Servers, databases, networks, and terminals • Notations related to system components 	<ul style="list-style-type: none"> • Understanding computerization initiatives • Collecting necessary information from the persons concerned • Analyzing businesses, and understanding their processing flows • Understanding the types of information that are entered and issued for specific business operations • Analyzing systems
	4-2 Determining the content of target business operations	<p>Organize business processes and information from the perspective of the system.</p>	<ul style="list-style-type: none"> • Target business operations 	<ul style="list-style-type: none"> • Analyzing the process of an information system and the information to be handled, in terms of the flow of target business operations and the organization
	4-3 Definitions of system-related issues in the target business operations	<p>Analyze specific problems of the target business operations, clarify the course of resolving the problems, and define issues that must be resolved with the prospective system.</p>	<ul style="list-style-type: none"> • Techniques for finding and resolving problems • Documentation 	<ul style="list-style-type: none"> • Associating business issues with an information system
	4-4 Analysis of the current system for the target business	<p>Understand the functions, data, systems architecture, maintenance, operational methods, operational framework, management framework, users, and quality of the current system that are achieving for the target business. Organize the functions and data so that they can be easily utilized for business</p>	<ul style="list-style-type: none"> • The current information system • Risk identification and impact of the risks • System failures • Documentation 	<ul style="list-style-type: none"> • Obtaining and organizing materials relating to the current information system • Understanding the characteristics of functions and data concerning the current information system

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		functions restructuring. In addition, identify relations with other systems associated with the target business, and understand the functions, data, operational methods, operational framework, management framework, and operational risks.		
	4-5 Studies of applicable information technologies	Study technology trends to establish a concrete overall picture of the business. When studying the trends, determine objectives, scope, and specific items to study. Consider how to apply the results of such study.	<ul style="list-style-type: none"> • Trends in information technology (including IoT, big data, AI, etc.) • Techniques for studying trends in information technology • Trends in information • IT evaluation techniques • Documentation • Application and management of intellectual properties 	<ul style="list-style-type: none"> • Studying and evaluating trends in information technology (including IoT, big data, AI, etc.) according to a study policy
	4-6 Creation of a business model	Concerning the target business operations and related business operations, organize them on the basis of the definitions of system-related issues in the target business operations, perform restructuring of the business functions, and model them as well as organizations. Based on the study of applicable information technologies, consider business functions to be targeted, and ensure consistency among the targeted functions. In addition, summarize the key changes of the business, organization, and system, as well as the specific issues of performing the business.	<ul style="list-style-type: none"> • Summarizing the key changes of a business and information system, as well as the specific issues of implementing the business • Business models • Business processes • Data classes (entities) • Notations of models • Documentation 	<ul style="list-style-type: none"> • Analyzing and defining a business model through associating business processes with data classes • Evaluating and deciding on a business model • Explaining a business model to the persons concerned • Finding consensus among conflicting opinions
	4-7 Organizing computerization functions and developing the systems architecture	Based on the business model, organize computerization functions for supporting the business functions targeted. Then, clarify what is to be developed and prioritized. Concerning the functions, describe the flow of information and process. Develop a systems architecture necessary for achieving the functions. In addition, clarify the configuration overview of main components (databases, servers, networks, and terminals) necessary for the functions.	<ul style="list-style-type: none"> • Systems architectures • Virtualization • Servers, networks, terminal, and databases • Software packages • OSS (Open source software) • Documentation • Application and management of intellectual properties • Cloud computing 	<ul style="list-style-type: none"> • Analyzing and organizing computerization functions • Evaluating and selecting a systems architecture
	4-8 Clarification of a basic policy about system	Clarify the general plan of the migration of the business and system in terms of such matters as a schedule for starting business with the new system, migration methods, basic requirements	<ul style="list-style-type: none"> • System migration • What to migrate 	<ul style="list-style-type: none"> • Predicting possible failures during migration and countermeasures for them • Explaining a migration policy and basic

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	migration	(the migration of databases and networks, the change of operational procedures, etc.), and a schedule for stopping the previous business and system.		requirements to the persons concerned, as well as making adjustments among them
	4-9 Clarification of a policy regarding cooperation with other systems	With regard to the other systems, clarify a policy of cooperation with the new system. If development of a new function is necessary, add it to the business model.	<ul style="list-style-type: none"> • Cooperation of systems • System functions as candidates for cooperation 	<ul style="list-style-type: none"> • Understanding the relation between information systems • Understanding the characteristics of functions and data with regard to information systems
	4-10 Clarification of a basic policy regarding system operations and maintenance	Clarify basic requirements such as a policy and schedule for actually maintaining and operating the system. Clarify the basic requirements of the maintenance framework and tasks for possible system failures. In addition, clarify a policy for performing the task of changing the system.	<ul style="list-style-type: none"> • System operations and maintenance • System reliability • Business operations and maintenance • Configuration management 	<ul style="list-style-type: none"> • Setting an indicator of system reliability • Identifying possible system failures • Considering cost restrictions on system operations and maintenance • Explaining a policy for system operations and maintenance to the persons concerned
	4-11 Clarification of a basic policy regarding the preparation of environments	Clarify a policy for the preparation of environments (for development, operations, and maintenance). Roughly estimate the cost of information system resources necessary for the preparation for each period. Also, calculate the possible amount of usage of the system resources.	<ul style="list-style-type: none"> • Roughly estimating the cost of system resources necessary for the preparation of environments for each period, as well as calculating the possible amount of usage of the system resources • Environments 	<ul style="list-style-type: none"> • Obtaining data for estimating the cost of the preparation of environments • Explaining the estimation of the periods and amount of usage to the persons concerned, as well as making adjustments among them
	4-12 Clarification of a basic policy regarding the reuse of existing systems	Concerning the continued use or migration (the reuse through conversion or other means) of existing systems, the use of business packages, and the use of external services, clarify such matters as the scope of functions, the configuration of necessary devices, and operational conditions.	<ul style="list-style-type: none"> • Reuse of systems • Migration • Use of business packages • Use of external services • Application and management of intellectual properties 	<ul style="list-style-type: none"> • Evaluating means for reusing systems
	4-13 Clarification of a basic policy regarding education and training	Concerning the education and training related to the business and system, clarify the basic requirements such as objectives, scope, education and training framework, equipment, environment, and implementation schedule.	<ul style="list-style-type: none"> • Users' needs with regard to education and training • Developers' needs with regard to education and training 	<ul style="list-style-type: none"> • Understanding needs with regard to education and training • Clarifying when education and training will be necessary
	4-14 Clarification of a basic policy regarding	Clarify the service level of the system in terms of such matters as reliability, performance, and security. Based on that, clarify basic requirements concerning the system quality and	<ul style="list-style-type: none"> • Quality standards adopted by companies • Security measures and contingencies • BCP (Business Continuity Plan) • Quality assurance 	<ul style="list-style-type: none"> • Determining the acquirer's quality requirements • Evaluating quality standards • Evaluating and selecting a quality assurance

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	service level and quality	the quality management framework (including safety and security measures).		process
	4-15 Consideration of feasibility	Concerning the requirements of the development, operations, maintenance, migration, environment preparation, and quality, consider whether the system can be technically and economically achieved on the basis of staff, delivery date, costs, and other prerequisites.	<ul style="list-style-type: none"> • Systems architectures • Application of system solutions 	<ul style="list-style-type: none"> • Determining the difficulty level of achieving a computerization plan • Determining acceptable ranges for the prerequisites of a computerization plan • Considering the problems and their countermeasures for a computerization plan • Explaining the feasibility of a computerization plan to the persons concerned
	4-16 Creation of the overall development schedule	Partition the entire prospective system into subsystems if necessary. Prioritize the subsystems upon studying the impact of each of them on related departments and business operations. Considering the staff, delivery date, costs, consistency, and other factors, create general development schedules for each of the subsystems.	<ul style="list-style-type: none"> • Partitioning into subsystems • Techniques for scheduling 	<ul style="list-style-type: none"> • Prioritizing subsystems to be developed • Explaining partitioning into subsystems, their prioritization, and their development schedules to the persons concerned, as well as making adjustments among them
	4-17 Development of a policy regarding the selection of system	Clarify the basic functional requirements, configuration requirements, and budget of (the hardware and software of) the prospective system to establish concrete organized computerization functions and the planned systems architecture. Determine the scope of the study regarding the system selection.	<ul style="list-style-type: none"> • Computerization functions • Systems architectures 	<ul style="list-style-type: none"> • Recognizing important matter regarding selection of system components • Determining the scope of the study regarding the system selection
	4-18 Projection of the costs and system investment effect	Provide a projection of the quantitative and qualitative effect of the system to be achieved. By establishing an assumption of the general timeframe, organization, and person-months of the development, operations, and maintenance, estimate the costs of achieving the system. By associating the effect with the costs, clarify the effect and timing of investing in the system.	<ul style="list-style-type: none"> • Quantitative and qualitative effect of computerization • Techniques for estimating the costs of developing, operating, and maintaining a system • Documentation 	<ul style="list-style-type: none"> • Applying past data to cost estimation • Considering cost risks • Projecting when the investment effect of a system will occur • Considering how to suppress costs • Explaining the investment effect of a system
	4-19 Support for the development of a project-promoting scheme	Based on the projection of the costs and investment effect of the system, support the development of a project-promoting scheme, for example, by checking the relevant prerequisites (person-months, staff, delivery date, costs, etc.).	<ul style="list-style-type: none"> • Organization structure 	<ul style="list-style-type: none"> • Planning an efficient promotion scheme within restrictions • Explaining the development of the project-promoting scheme to the persons concerned, as well as making adjustments among them
	4-20 Verification of conformity to business	Determine the feasibility of the business goal, business strategy, information strategy, and computerization initiative by verifying the	<ul style="list-style-type: none"> • Information strategies • Computerization initiatives • Business models 	<ul style="list-style-type: none"> • Determining conformity to business goal, business strategy, information strategy, and computerization initiative

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	strategy, information strategy, and computerization initiative	consistency of the business model, the feasibility of the systems architecture, and the correctness of the investment effect of the system.	<ul style="list-style-type: none"> • Systems architectures • System investment effect 	
	4-21 Documentation of a computerization plan and obtaining its approval	<p>Document the following items concerning computerization planning. Then, obtain the approval from the person in charge of the department of information systems or from the CIO:</p> <ul style="list-style-type: none"> • Specific person-months, costs, and schedule for developing, operating, and maintaining the system • What is needed for outsourcing (when applicable), such as relevant work items and schedule • Prerequisites of the basic requirements of the preparation of environments, education and training, and quality 	<ul style="list-style-type: none"> • Description format standards for computerization plans • Documentation 	<ul style="list-style-type: none"> • Explaining a computerization plan to the person in charge of the promotion of an information strategy, and obtaining his/her approval • Explaining a computerization plan to the persons concerned with the promotion of the information strategy and asking for cooperation from them • Finding consensus among conflicting opinions
III Requirements Definition Identification of requirements and definition of restrictions; definition of business requirements; clarification of the requirements of the organizations and their environments; definition of functional requirements; definition of non-functional requirements; definition of schedule requirements; etc.				
5 Identification of Requirements	5-1 Identifying stakeholders' requirements and defining restrictions	<p>Organize stakeholders' needs, desires, requests, expectations, and perceived restrictions. Then, express them in terms of a model that may be textual or formal and document them. Stakeholder' requirements include the needs and requirements imposed by society, the restrictions imposed by an acquiring organization and the capabilities and operational characteristics of users and operating staff. In addition, define the restrictions on a system solution that are unavoidable consequences of existing agreements, management decisions, and technical decisions.</p>	<ul style="list-style-type: none"> • Business operations and terminology • How to collect information • How to analyze business operations • Techniques for modeling • System engineering • Organization theories • Requirements acquisition method 	<ul style="list-style-type: none"> • Identifying key persons (as information sources) from users • Practicing techniques and procedures for information collection • Determining the necessary amount of information to be collected • Modeling and analyzing business operations • Categorizing needs, prerequisites, and restrictions for computerization • Assessing whether a system can address the needs, prerequisites, and restrictions
	5-2 Definition of business requirements	<p>Through organizing the new business model and operations, define requirements to be met for the business operations. The business requirements include the following:</p> <ul style="list-style-type: none"> • Business operations (procedures, input/output information, organizations, responsibilities, privileges, etc.) 	<ul style="list-style-type: none"> • Business processes of each industry or those of major companies • Best practice of each industry • Expertise and specific practices of each industry • How to analyze business operations • Business operations and terminology 	<ul style="list-style-type: none"> • Understanding business operations • Partitioning the business operations into appropriate units of small working steps • Clarifying the working steps • Documenting concepts concisely

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		<ul style="list-style-type: none"> • Business characteristics (rules, restrictions, etc.) • Business terminology • Relation between the business and its external environment; information to be received 	<ul style="list-style-type: none"> • Business restrictions • Business implementation 	
	5-3 Clarifying the requirements of the organizations and their environments	Clarify the requirements of the organizations such as their structures, staff, and size. Then, create a policy, plan, and schedule for introducing offices and facilities that are necessary for the new business.	<ul style="list-style-type: none"> • Organization theories • Business restrictions • Business implementation • System operations 	<ul style="list-style-type: none"> • Considering organizational structures • Considering system operations • Ensuring consistency between a system and business • Coordinating the interests of the persons concerned • Explaining the results of the considerations to the persons concerned • Understanding business operations • Documenting concepts concisely
	5-4 Definition of functional requirements	Clarify items such as the following in terms of system functions for meeting business requirements: <ul style="list-style-type: none"> • Flow of information (or data) among the functions that constitute the business • Work to be done by target people • Scope of system functions to be implemented • With regard to information management, its viewpoint, unit, and form • Interfaces with other systems to exchange information 	<ul style="list-style-type: none"> • Business operations and terminology • Analysis of business operations • Workflow notation • Methodology of developing a business model • Methodology of developing a data model • Simulation techniques 	<ul style="list-style-type: none"> • Understanding target business operations • Collecting and organizing information from the persons concerned • Obtaining a consensus among the persons concerned • Explaining study results to the persons concerned • Developing business models and data models in accordance with model development methods • Creating simulation models • Understanding details of business operations • Documenting concepts concisely
	5-5 Definition of non-functional requirements	Clarify non-functional requirements (i.e., requirements other than those concerning the system functions) for meeting business requirements. For non-functional requirements include items such as the following: <ul style="list-style-type: none"> • Quality requirements: functionality, reliability, usability, efficiency, maintainability, and portability • Technical requirements: system implementation methods; system configuration; system development schemes (e.g., language); development criteria and 	<ul style="list-style-type: none"> • Computerization and system integration • Functions and operation of systems • Development processes and development capabilities • Software quality requirements • Quality assurance • Security technologies • Program testing • Development environments such as middleware, tools, framework, and programming languages • Cost estimation • How to estimate expected effects 	<ul style="list-style-type: none"> • Collecting information from the persons concerned, and organizing it • Obtaining a consensus among the persons concerned • Explaining study results to the persons concerned • Defining as system requirements, requests from the persons concerned • Identifying conflicting demands, and presenting solutions • Applying effective technologies to fulfill requirements • Analyzing the importance of data

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		<p>standards; and development environments</p> <ul style="list-style-type: none"> Operational and manipulative requirements: system operational procedures; styles of system operations; schedules of system operations; system monitoring methods and standards; service provision conditions (e.g., failure recovery time); disaster countermeasures; business continuity measures; data storage cycle and amount; and how users manipulate the system Migration requirements: business operations to be migrated, software to be migrated, hardware to be migrated, migration procedures, and when to migrate Associated work: environmental setting; deployment of terminals; user education; and support for operations 	<ul style="list-style-type: none"> Process management Databases Networks Terminals Ergonomics Interfaces 	<ul style="list-style-type: none"> Identifying risk types Analyzing the correctness and consistency of information Comprehensively handling specific requests Documenting concepts concisely
	5-6 Definition of schedule requirements	Consider when to start the operations of the system for achieving the defined requirements, and define schedule requirements.	<ul style="list-style-type: none"> Effect of system characteristics on development methods Relation between development period, development budget, and resources 	<ul style="list-style-type: none"> Determining the scale, scope, and complexity of a system Estimating development period and costs
IV Development System requirements definition; systems architecture design; software requirements definition; software architecture design; software detailed design; system integration; system qualification tests; software installation and system installation; software acceptance support and system acceptance support; etc.				
6 Preparation for System Development	6-1 Selection of a life cycle model for development work ¹⁾	Define or select a software life cycle model appropriate to the scope, scale, and complexity of the project.	<ul style="list-style-type: none"> Effect of system characteristics on development methods Relation between development period, development budget, and resources Software life cycle models Relation between model and processes 	<ul style="list-style-type: none"> Determining the scale, scope, and complexity of a system Estimating development period and costs Selecting a software life cycle model that matches the project Selecting necessary processes
	6-2 Preparation of the development environments	Prepare the development environments through selecting what are used for each process (standards, methods, tools, etc.).	<ul style="list-style-type: none"> Implementation of each process Development standards Development methods Tools, middleware, framework, and programming languages OSS (Open Source Software) Hardware 	<ul style="list-style-type: none"> Selecting and modifying processes through considering resources and budget Identifying important elements of a development environment Selecting development environments necessary for each process
	6-3 Creation of a system development process	Document a specific plan for determining the scope of the project and performing each process.	<ul style="list-style-type: none"> Documentation of an implementation plan Relation between each process, resources, and person-months Risk management 	<ul style="list-style-type: none"> Creating a plan for implementation, on a process-by-process basis Based on an understanding of the overall situation, maintaining consistency between

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	implementation plan	In implementing this plan, give development staff guidance as necessary, and proceed with activities such as designing, developing, and testing.	<ul style="list-style-type: none"> • Security • Project management 	<ul style="list-style-type: none"> plans for each process • Considering the efficient deployment of staff • Understanding skills of the staff • Grasping the implementation status of development accurately • Anticipating risks • Considering measures against the risks • Guiding development staff • Leading a team
7 System Requirements Definition	7-1 Definition of system requirements	Analyze the specific intended use of the system to be developed. Then, define and document system requirements such as the following: <ul style="list-style-type: none"> • Aim and scope of the computerization • Functionality/capability and life cycle of the system • Requirements for corresponding business, organizations, and users • Requirements for reliability, safety, security, ergonomics, interfaces, operation, and maintenance • System configuration requirements • Design restrictions and qualification requirements • Development environments • Quality, costs, and expected effect • Requirements for system migration and for its validity check • Definition of basic requirements for main databases 	<ul style="list-style-type: none"> • Computerization and system integration • Functions and operation of systems • Development processes and development capabilities • Software quality requirements • Quality assurance • Security technologies • Program testing • Development environments such as middleware, tools, framework, and programming languages • Cost estimation • How to estimate expected effects • Process management • Databases • Networks • Terminals • Ergonomics • Interfaces 	<ul style="list-style-type: none"> • Defining system requirements with requests from stakeholders • Identifying conflicting demands, and presenting solutions • Applying effective technologies to fulfill requirements • Analyzing the importance of data • Identifying risks • Analyzing the correctness and consistency of information • Comprehensively handling specific requests • Documenting defined issues in an understandable way • Selecting efficient test techniques
	7-2 Evaluation of the system requirements	Considering the following criteria, evaluate the system requirements and document the results: <ul style="list-style-type: none"> • Traceability of the acquisition needs • Consistency with the acquisition needs • Testability • Feasibility of systems architecture design • Feasibility of the operations and maintenance 	<ul style="list-style-type: none"> • Purposes of system construction • Basic functions of systems • Test techniques for systems • System prototyping • System simulations • Operations and maintenance of systems 	<ul style="list-style-type: none"> • Understanding users' requests concerning operations as requirements for system operations • Associating acquisition needs with system requirements • Designing effective prototypes • Designing effective simulations • Explaining how to operate and maintain systems • Analyzing the correctness and consistency of information • Finding consensus among conflicting requests

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	7-3 Joint review of the system requirements	Review the system requirements definition.	<ul style="list-style-type: none"> Review methods How to proceed with a review Environments for system development and operations Matters and notes to be included in a document of defined system requirements definition document 	<ul style="list-style-type: none"> Building a consensus among stakeholders Reviewing Describing priority matters explicitly Selecting communication methods appropriate for reviewing the system requirements definition document, and effectively proceeding with the review Appropriately evaluating opposing opinions Clarifying problems and finding solutions Reconciling the persons concerned, and obtaining a consensus among them
8 Systems architecture Design	8-1 Establishment of a system architecture	Establish a top-level architecture of the system. Identify items of hardware, software, and manual work. Ensure that all the system requirements are allocated to these items. Based on these items, identify hardware configuration items, software configuration items, and manual operations. Then, document the systems architecture as well as the system requirements allocated to the above items.	<ul style="list-style-type: none"> Target business operations Hardware Software Cost estimation Project risks Systems architecture design concepts and technologies Systems architecture design document contents Quality assurance Configuration management 	<ul style="list-style-type: none"> Documenting a systems architecture accurately Evaluating each computerization plan candidate, and explaining it to the persons concerned Identifying core requirements for the systems architecture Selecting technologies with considerations for cost-effectiveness Allocating system requirements in accordance with consistent criteria Planning to ensure quality for the process of system development
	8-2 Creation of provisional user documents	Create provisional user documents.	<ul style="list-style-type: none"> How to write and what needs to be written for user documents. Business System operations Design and implementation of a GUI Document version control 	<ul style="list-style-type: none"> Creating user documents
	8-3 Definition of test requirements for system integration	As developer, define and document provisional test requirements and schedule for system integration.	<ul style="list-style-type: none"> Test techniques Test tools System requirements Target business operations 	<ul style="list-style-type: none"> Setting a test policy in accordance with a computerization concept Determining key elements for checking system practicality Obtaining a consensus among stakeholders regarding test policy
	8-4 Evaluation of the systems architecture	Considering the following criteria, evaluate the systems architecture and the requirements for the items, and document the results: <ul style="list-style-type: none"> Traceability of the system requirements Consistency with the system requirements Appropriateness of the design standards and 	<ul style="list-style-type: none"> Design standards and techniques Development methods for software configuration items Operations and maintenance 	<ul style="list-style-type: none"> Interpreting system requirements, and associating them with a systems architecture Analyzing and constructing the logical consistency of a system Understanding the core of a problem, and resolving it

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		<p>methods to be used</p> <ul style="list-style-type: none"> • Feasibility of the software items that meet the allocated system requirements • Feasibility of the operations and maintenance 		<ul style="list-style-type: none"> • Finding consensus among conflicting requests • Building a consensus among stakeholders
	8-5 Joint review of the systems architecture design	Review the systems architecture design.	<ul style="list-style-type: none"> • Review methods • How to proceed with a review • Environments for system development and operations • Matters and notes to be included in a systems architecture design document 	<ul style="list-style-type: none"> • Reviewing • Describing priority matters explicitly • Selecting communication methods appropriate for reviewing system requirements, and effectively proceeding with the review • Appropriately evaluating opposing opinions • Clarifying problems and finding solutions • Making adjustments and obtaining a consensus among the persons concerned
9 Software Requirements Definition	9-1 Establishment of software requirements	<p>Establish and document the following software requirements (including the specifications of quality characteristics):</p> <ul style="list-style-type: none"> • Performance and physical characteristics • Specifications of functionality/capability that include environmental conditions under which software items²⁾ operate • External interfaces of the software items • Qualification requirements³⁾ • Safety specifications, including those related to methods of operation and maintenance, environmental influences, and personnel injury • Security specifications, including those related to leakage of confidential information • Ergonomic specifications with consideration given to human errors, and education and training (including those related to manual operations, human-equipment interactions, constraints on personnel, and areas needing concentrated human attention) • Data definition and database requirements • Requirements concerning installation and acceptance of software products at the operation and maintenance sites • User documentation requirements • User operation and execution requirements • User maintenance requirements 	<ul style="list-style-type: none"> • Establishment of software requirements • Software quality characteristics • Software documents 	<ul style="list-style-type: none"> • Establishing software requirements that appropriately reflect system requirements • Establishing software requirements that are technically feasible • Documenting software requirements accurately

Major category	Minor category	Outline	Required knowledge	Required skills
	9-2 Evaluation of the software requirements	<p>Considering the following criteria, evaluate the software requirements and document the results:</p> <ul style="list-style-type: none"> • Traceability of the system requirements and system design • External consistency with the system requirements • Internal consistency • Testability • Feasibility of software design • Feasibility of the operations and maintenance 	<ul style="list-style-type: none"> • Establishment of software requirements • Software quality characteristics • Software documents 	<ul style="list-style-type: none"> • Interpreting system requirements and system design, and associating them with software requirements • Comprehensive judgment • Analyzing and constructing software consistency • Understanding the core of a problem, and resolving it • Reviewing • Finding consensus among conflicting requests • Building a consensus among stakeholders
	9-3 Joint review of the software requirements	<p>Review the software requirements definition.</p>	<ul style="list-style-type: none"> • How to describe software requirements • Review methods 	<ul style="list-style-type: none"> • Helping relevant people such as those in charge of the business (other than IT engineers) understand software requirements with unerring precision • Explaining technical information in terms of effect on business • Selecting communication methods appropriate for reviewing system design, and effectively proceeding with the review • Reconciling the persons concerned, and obtaining a consensus among them
10 Software Architecture Design	10-1 Architecture design for a software structure and software components	<p>Convert the requirements of the software items into an architecture that describes its top-level structure and identifies the software components. Ensure that all the requirements of the software items are allocated to the software components and further decomposed into small pieces to facilitate detailed design. Then, document the architecture of the software items.</p>	<ul style="list-style-type: none"> • Software design techniques • Standardization • System configuration 	<ul style="list-style-type: none"> • Understanding the contents of system specifications, and partitioning subsystems into components • Embodying quality requirements
	10-2 Architecture design for each interface	<p>Develop and document a top-level design for the external interfaces of the software items and the interfaces between the software components of the software items.</p>	<ul style="list-style-type: none"> • Software design techniques • Standardization • System coordination 	<ul style="list-style-type: none"> • Designing consistent interfaces between components
	10-3 Design for databases at the top level	<p>Design a top-level design for databases, and document it.</p>	<ul style="list-style-type: none"> • Conversion from a conceptual data model into a logical data model • Normalization/denormalization, relational theory, and data-modeling tools 	<ul style="list-style-type: none"> • Smoothly performing database design with the help of experts as necessary • Understanding and explaining the relation between a data model and a database
	10-4 Definition of test requirements for software	<p>For software integration, define and document provisional test requirements and schedule.</p>	<ul style="list-style-type: none"> • Software detailed design • Software architecture design • Test tools • Test techniques 	<ul style="list-style-type: none"> • Interpreting software architecture design, and setting test requirements • Setting a test policy in accordance with the characteristics of software configuration items

Major category	Minor category	Outline	Required knowledge	Required skills
	integration			
	10-5 Evaluation of the software architecture design	<p>Considering the following criteria, evaluate the architecture of the software items and the interface and database designs, as well as document the results:</p> <ul style="list-style-type: none"> • Traceability of the software item requirements • External consistency with the requirements of the software items • Internal consistency of the software components • Appropriateness of the design methods and work standards being used • Feasibility of detailed design • Feasibility of the operations and maintenance 	<ul style="list-style-type: none"> • Software architecture design • Software quality characteristics • Software documents 	<ul style="list-style-type: none"> • Interpreting software architecture design, and associating it with software requirements • Comprehensive judgment • Understanding the core of a problem, and resolving it • Finding consensus among conflicting requests • Building a consensus among stakeholders
	10-6 Joint review of the software architecture design	Review the software architecture design.	<ul style="list-style-type: none"> • Documentation of software architecture design • How to proceed with a review • Development processes • Operational environments 	<ul style="list-style-type: none"> • Reviewing • Selecting communication methods appropriate for reviewing software architecture design, and effectively proceeding with the review • Explaining the logical design of software components • Appropriately evaluating opposing opinions • Suggesting alternatives • Presenting the best plan through holistic thinking
11 Software Detailed Design	11-1 Detailed design for the software components	Perform detailed design for each software component of the software items. Decompose the software components into lower levels containing software units that can be coded, compiled, and tested. Ensure that all the software requirements are allocated from the software components to the software units. Then, document the results of the detailed design.	<ul style="list-style-type: none"> • Software detailed design • Writing techniques to accurately document program logic • IDE (Integrated Development Environment) • Programming languages 	<ul style="list-style-type: none"> • Designing software components so that they can be consistent with their specifications • Organizing matters to be discussed, and assembling them as detailed specifications • Selecting the most appropriate design technique • Selecting the most appropriate development environment for a system
	11-2 Detailed design for the software interfaces	Develop and document a detailed design for the external interfaces of the software items, the interfaces between the software components, and the interfaces between the software units.	<ul style="list-style-type: none"> • Software design techniques • Standardization 	<ul style="list-style-type: none"> • Designing consistent interfaces between software units
	11-3 Detailed design for the databases	Develop and document a detailed design for databases.	<ul style="list-style-type: none"> • Conversion from a logical data model into a physical data model • Normalization/denormalization, relational theory, and data-modeling tools 	<ul style="list-style-type: none"> • Smoothly performing the implementation and operations of databases with the help of experts as necessary • Understanding and explaining the relation

Major category	Minor category	Outline	Required knowledge	Required skills
			<ul style="list-style-type: none"> • Target environments 	<ul style="list-style-type: none"> • between databases and software • Understanding and smoothly performing the steps needed to create a database • Evaluating target environments
	11-4 Update of the user documents	Update the user documents as necessary.	<ul style="list-style-type: none"> • How to write and what needs to be written for user documents • Business • System operations • Design and implementation of a GUI • Document version control 	<ul style="list-style-type: none"> • Selecting communication methods for reviewing user documents, and effectively proceeding with the review • Presenting a GUI decided through its detailed design, and gaining the understanding of review participants • Explaining to the persons concerned what parts of user documents were changed, and the reason for the change
	11-5 Requirements definition for software unit testing	Define and document test requirements and the schedule for testing software units. Include the load test of the software unit at the limits of its requirements in the test requirements.	<ul style="list-style-type: none"> • Design of specifications for software unit testing • Test tools • Development processes • Implementation environments 	<ul style="list-style-type: none"> • Evaluating a plan for software unit testing
	11-6 Update of the test requirements for software integration	For software integration, update the test requirements and schedule.	<ul style="list-style-type: none"> • Software detailed design • Software architecture design • Test tools • Test techniques 	<ul style="list-style-type: none"> • Interpreting software architecture design, and setting test requirements • Setting a test policy in accordance with the characteristics of software configuration items
	11-7 Evaluation of the software detailed design and the test requirements	<p>Considering the following criteria, evaluate the software detailed design and the test requirements, and document the results:</p> <ul style="list-style-type: none"> • Traceability of the software item requirements • External consistency with the architecture design of the software items • Internal consistency between the software components and the software units • Appropriateness of the design methods and work standards being used • Feasibility of the tests • Feasibility of the operations and maintenance 	<ul style="list-style-type: none"> • Specifications of software components • Design of specifications for testing • Test tools • Test techniques 	<ul style="list-style-type: none"> • Interpreting software detailed design, and associating it with software component specifications • Evaluating a test policy in accordance with the characteristics of software configuration items • Evaluating methods for the extraction and verification of the important points of the software configuration items • Evaluating a cost-effective test policy

Major category	Minor category	Outline	Required knowledge	Required skills
	11-8 Joint review of the software detailed design	Review the contents of the software detailed design.	<ul style="list-style-type: none"> • Documentation of detailed design • How to proceed with a design review • Development processes • Program implementation environments • Operational environments 	<ul style="list-style-type: none"> • Selecting communication methods appropriate for reviewing detailed design, and effectively proceeding with the review • Explaining the logic of the detailed design • Appropriately evaluating opposing opinions • Understanding the state of program implementation, and pointing out its problems
12 System Integration	12-1 Creation of a system integration plan	Create a plan for integrating the software configuration items, the hardware configuration items, the manual operations, and (if necessary) other systems into system items. Include test requirements, procedures, data, responsibilities, and schedule in this plan. Then, document the plan.	<ul style="list-style-type: none"> • Test procedures • Iterative test processes • Error analysis and resolution processes • Software qualification 	<ul style="list-style-type: none"> • Identifying, resolving, and correcting malfunctions and failures • Investigating and analyzing the situation, and proposing solutions • Examining the qualification of software
	12-2 Performing of a system integration test	Integrate the software configuration items, with the hardware configuration items, the manual operations, and other systems as necessary, into the system. Test the aggregated items, as development progresses, in comparison with their requirements. Then, document the results of the integration and the test.	<ul style="list-style-type: none"> • Test procedures • Test techniques • Test tools • Quality assurance 	<ul style="list-style-type: none"> • Evaluating test results • Identifying, resolving, and correcting malfunctions and failures • Investigating and analyzing situations, and proposing solutions • Systematically organizing processes and results, and documenting them as detailed evidence • Evaluating performance • Evaluating usability • Evaluating test procedures
	12-3 Preparation for a system qualification test	Create and document a series of tests, test cases (input, output, and test criteria), and test procedures to perform system qualification tests for each of the system qualification requirements. Ensure that the integrated system is ready for system qualification tests. Before performing the tests, create various master data and transaction data, and register them in a test environment.	<ul style="list-style-type: none"> • Software quality assurance • Software reliability • Scheduling for tests • Organization of a test framework • Test techniques • Design and creation of test data • How to evaluate test results • Documentation of test results • Establishment of a test environment • Equipment and tools for tests 	<ul style="list-style-type: none"> • Creating reasonable test schedules • Estimating resources and staff necessary for performing tests • Selecting test techniques according to the characteristics of a project
	12-4 Evaluation of the system integration	Considering the following criteria, evaluate the integrated system, and document the results: <ul style="list-style-type: none"> • Test coverage of the system requirements • Appropriateness of used test methods and work standards • Conformity to expected results • Feasibility of system qualification tests 	<ul style="list-style-type: none"> • Documentation of test results • Error analysis and resolution processes • Forms for reporting test results • Quality assurance • Estimation of remaining malfunctions • Quality evaluation 	<ul style="list-style-type: none"> • Evaluating automatic test tools • Evaluating test coverage • Considering ideas for improving test procedures • Analyzing the impact of remaining malfunctions

Major category	Minor category	Outline	Required knowledge	Required skills
		<ul style="list-style-type: none"> Feasibility of the operations and maintenance 	<ul style="list-style-type: none"> Improvement of system development processes 	<ul style="list-style-type: none"> Evaluating the applicability of system development processes
	12-5 Joint review of the system integration	Review the results of the system integration test.	<ul style="list-style-type: none"> Documentation of test results Error analysis and resolution processes Forms for reporting test results Quality assurance Estimation of remaining malfunctions Quality evaluation 	<ul style="list-style-type: none"> Evaluating test coverage Considering ideas for improving test procedures Analyzing the impact of remaining malfunctions
13 System Qualification Tests	13-1 Performing of system qualification tests	Perform system qualification tests according to the defined system qualification requirements. Ensure that the implementation of each software requirement is tested for compliance, and that the system is ready to be delivered. Then, document the test results.	<ul style="list-style-type: none"> Test procedures Iterative test processes Error analysis and resolution processes System qualification 	<ul style="list-style-type: none"> Identifying, resolving, and correcting malfunctions and failures Investigating and analyzing situations, and proposing solutions Understanding the architecture and hierarchy of a system Systematically organizing processes and results, and documenting them as detailed evidence
	13-2 Evaluation of the system	Considering the results of the system qualification tests and the following criteria, evaluate the system and document the results: <ul style="list-style-type: none"> Test coverage of the system requirements Conformity to expected results Feasibility of the operations and maintenance Appropriateness of used test techniques and standards 	<ul style="list-style-type: none"> Documentation of test results Error analysis and resolution processes Forms for reporting test results Quality assurance Estimation of remaining malfunctions Quality evaluation Improvement of system development processes 	<ul style="list-style-type: none"> Evaluating automatic test tools Evaluating test coverage Considering ideas for improving test procedures Analyzing the impact of remaining malfunctions Evaluating the applicability of system development processes
	13-3 Update of the user documents	Update user documents. This includes revision of manuals for business operations.	<ul style="list-style-type: none"> How to write user documents Procedures for updating documents Business operations 	<ul style="list-style-type: none"> Explaining to the persons concerned what parts of user documents were changed, and the reason for the change
	13-4 Support for an audit ⁴⁾	Support an audit. Then, document the results.	<ul style="list-style-type: none"> Audits 	<ul style="list-style-type: none"> Supporting an audit
	13-5 Preparation of deliverable software products and systems	As a developer, if the results of the audit are good, update and prepare the deliverable software products and systems, for software and system installation as well as software and system acceptance support.	<ul style="list-style-type: none"> How to configure software products to be delivered Preparation procedures for delivery Handover of deliverables to the operations and maintenance phase 	<ul style="list-style-type: none"> Configuring software as well as related materials and documents in the form of delivery Explaining matters of software delivery
	13-6 Preparation of software products and systems to be handed over to the	Of the deliverables created through the development work, organize and prepare those to be handed over to the operations and maintenance phase.	<ul style="list-style-type: none"> Deliverables created through development work Configuration of development environments Software products to be used in operational environments 	<ul style="list-style-type: none"> Configuring software products to be used in operational environments

Major category	Minor category	Outline	Required knowledge	Required skills
	operations and maintenance phase			
14 Software and System Installation	14-1 Creation of a software and system installation plan	Create a plan for installing the software products in an actual environment. In addition, help the acquirer create a plan for installing the systems. Determine resources and information that are necessary for installing the software products and systems, and make them available. Assist the acquirer with set-up activities (if specified in the contract). If the software products and systems to be installed replace existing products and systems, support parallel operations that are required by contract. Document the installation plan.	<ul style="list-style-type: none"> Existing systems Software and system installation Parallel operations with existing systems 	<ul style="list-style-type: none"> Creating a software and system installation plan that minimizes impact on existing systems Supporting the acquirer upon set-up activities Clarifying and documenting provisions
	14-2 Execution of the software and system installation	Install the software products according to the installation plan. In addition, help the acquirer install the systems. Ensure that the software code and databases are initialized, executed, and terminated as specified in the contract. Then, document the incidents and results of the installation.	<ul style="list-style-type: none"> Installation procedures of software products and systems Problems of data conversion and resolution procedures for them Problems of compatibility and resolution procedures for them Hardware configuration Systems architectures, hardware, and software 	<ul style="list-style-type: none"> Installing software products and supporting system installation according to an installation plan Using a continuous improvement strategy and the tools for that Resolving contradictions in a timely manner Establishing multiple schedules, managing milestones, and making adjustments among them
15 Software and System Acceptance Support	15-1 Performing of an acceptance review and test by the acquirer	Help the acquirer perform an acceptance review and test. For this review and test, consider the results of the joint review, audit, software qualification test, and system qualification test. Then, document the results of this review and test.	<ul style="list-style-type: none"> How to describe test procedures How to operate in business 	<ul style="list-style-type: none"> Helping the acquirer accept the software products Expressing test procedures so that users may easily understand them
	15-2 Delivery of the software products and systems	As supplier, complete and deliver the software products and systems as specified in the contract.	<ul style="list-style-type: none"> How to configure software products and systems to be delivered Preparation procedures for delivery Handover of deliverables to the operations and maintenance phase 	<ul style="list-style-type: none"> Configuring software products and systems as well as related materials and documents in the form of delivery Explaining matters concerning the delivery of software products and system
	15-3 Education, training, and support for the acquirer	Provide the acquirer with initial and continuous education, training, and support as specified in the contract.	<ul style="list-style-type: none"> Users' operation of software and systems General users' level of knowledge of operation 	<ul style="list-style-type: none"> Planning education, training, and support in accordance with users' capability of software and system operation Providing users with education, training, and support

Major category	Minor category	Outline	Required knowledge	Required skills
V Operations and Maintenance Operational tests; migration of the business and system; evaluation of the system operations; evaluation of the business operations; evaluation of investment effect including effect on the business; analysis of problems and changes with regard to maintenance; etc.				
16 Operational Preparation and Operational Tests	16-1 Creation of the operational process implementation plan	Considering the operational policy and restrictions, create the following plans and establish an operational standard: <ul style="list-style-type: none"> • Allocation of roles based on classification between the acquirer and supplier, between operators and users, etc. • Consideration of operations modes such as ordinary operations, maintenance, training, emergencies, and parallel operations of old and new systems • A training plan for operations 	<ul style="list-style-type: none"> • Operations management in general • Trends in operations management techniques 	<ul style="list-style-type: none"> • Evaluating the feasibility of operational requirements • Explaining the concept of an operational plan to the persons concerned, and obtaining a consensus among them
	16-2 Design of operations	Design system operations in terms of such matters as methods, framework, staff, and procedures.	<ul style="list-style-type: none"> • Operations management in general • Problem management procedures for system operations • Operational procedures • Operations management tools 	<ul style="list-style-type: none"> • Creating solutions to the problems of current operations management • Evaluating the validity of operational design methods • Providing system operators with necessary information
	16-3 Operational test planning	Create an operational test plan, and establish criteria for completion of operational tests.	<ul style="list-style-type: none"> • Software quality assurance • Software reliability • Scheduling for tests • Organization of a test framework • Test techniques • Design and creation of test data • How to evaluate test results • Documentation of test results • Establishment of a test environment • Equipment and tools for tests 	<ul style="list-style-type: none"> • Creating reasonable test schedules • Estimating resources and staff necessary for performing tests • Selecting test techniques according to the characteristics of a project
	16-4 Preparation for the operational tests	Establish an environment for performing the operational tests.	<ul style="list-style-type: none"> • Operational environments for systems • Characteristics of system users 	<ul style="list-style-type: none"> • Judging the appropriateness of an environment for performing operational tests • Judging the appropriateness of operating the backup and recovery of a system
	16-5 Performing of the operational tests	Perform the operational tests for each release of the systems and software products. If the test results satisfy the given criteria, deploy the release for the actual operations. Based on the test results, review and update the user documents. If the operational test finds items that do not satisfy the given operational criteria, discuss it	<ul style="list-style-type: none"> • Test procedures • Test techniques • Test tools • Quality assurance 	<ul style="list-style-type: none"> • Evaluating test results • Identifying, resolving, and correcting malfunctions and failures • Investigating and analyzing situations, and proposing solutions • Making adjustments to the interests among the persons concerned

Major category	Minor category	Outline	Required knowledge	Required skills
		with user departments and adopt the relevant measures.		<ul style="list-style-type: none"> • Explaining the results of the considerations to the persons concerned • Systematically organizing processes and results, and documenting them as detailed evidence • Evaluating performance • Evaluating usability • Evaluating test procedures
	16-6 Checking of the results of the operational tests	Ensure that the software code and databases are initialized, executed, and terminated as described in the plan.	<ul style="list-style-type: none"> • Documentation of test results • Error analysis and resolution processes • Forms for reporting test results • Quality assurance • Estimation of remaining malfunctions • Quality evaluation 	<ul style="list-style-type: none"> • Evaluating test coverage • Considering ideas for improving test procedures • Analyzing the impact of remaining malfunctions
	16-7 Training for system operations	Help system operators train themselves through the creation of training plans and materials for system operations.	<ul style="list-style-type: none"> • System operations 	<ul style="list-style-type: none"> • Providing system operators with education, training, and support
17 Migration of the Business and System	17-1 Planning and implementation of a migration	<p>Clarify the difference between the old and the new in terms of workflow and computerization scope. Identify what tasks will be required for ensuring business continuity. Then, create, document, and implement a business and system migration plan.</p> <p>This plan includes the following:</p> <ul style="list-style-type: none"> • Confirmation of the requirements of a post-migration environment for actual operations (i.e., a new operational environment) • Learning of the new operational environment • Development of migration tools • Creation or preparation of migration data (master data to be newly created, data to be migrated from the old system, etc.) • Documentation for a migration (manuals for migration procedures, manuals for the procedures of business and system operations during and after migration, etc.) • Plan for performing the old and the new operational procedures in parallel • Preparation of resources necessary for a migration (staff, equipment, space, power supply, lines, 	<ul style="list-style-type: none"> • Business operations • Business restrictions • Data migration • Test tools • Old and new systems • Migration tools • Past problems with migration • Operations and maintenance 	<ul style="list-style-type: none"> • Finding out the impact of migration on business operations, and considering measures to deal with it • Creating a rational plan for system migration • Explaining the system migration plan to the persons concerned, and making adjustments to different opinions • Judging the impact of problems that may arise during system migration • Verifying and evaluating the results of a system migration

Major category	Minor category	Outline	Required knowledge	Required skills
		etc.) <ul style="list-style-type: none"> • Migration rehearsals • Prediction of and preventative measures against problems that may arise during migration • Migration implementation (including switching from the old to the new operational procedures) • Verifying the implemented migration, and checking its validity (including a check of switching from the old to the new operational procedures) • Support for the old operational environment after the migration 		
	17-2 Review for evaluating the migration	Review the new operations to evaluate the effect of migration to the new environment. Report the review results to the persons concerned (including users).	<ul style="list-style-type: none"> • Review methods 	<ul style="list-style-type: none"> • Understanding the core of a problem, and resolving it • Reviewing • Building a consensus among stakeholders
	17-3 Maintaining the data related to the old environment and ensuring its safety	Keep accessible the data used in or related to the old environment. Access to this data must follow contractual requirements with regard to protecting and auditing data.	<ul style="list-style-type: none"> • System configuration 	<ul style="list-style-type: none"> • Appropriately maintaining an old environment
18 Evaluation of the System Operations	18-1 Evaluation of the system operations	On receiving an evaluation report on system operations from a system administrator, consider the requests for system improvements, especially in terms of information strategies concerning the following: <ul style="list-style-type: none"> • Achievement levels of requirements and particular usages • Response time; processing time; and usage of resources • System failure frequency; number of failures; recovery time; and availability • Safety and security • Operators' workload; and usability for users • Management of the system operational hours • Management of data and media • Effect of the operations 	<ul style="list-style-type: none"> • Evaluation reports on system operations • Configuration management 	<ul style="list-style-type: none"> • Analyzing the achieved status of requests from the persons concerned • Collecting major needs for system improvements

Major category	Minor category	Outline	Required knowledge	Required skills
19 Evaluation of the Business Operations	19-1 Evaluation of the business operations	<ul style="list-style-type: none"> • Management of facilities and consumables <p>On receiving an evaluation report on business operations from a system administrator, evaluate them and consider requests for their improvements in terms of the following matters:</p> <ul style="list-style-type: none"> • Achievement levels of requirements and particular usages • Impacts of the migration of the system and business operations • System usability during the business operations • Operations and management of the resources installed on the users' side • How easily users can receive support and training • Requests for improving the business to make it adaptable to the conditions of business fields 	<ul style="list-style-type: none"> • Evaluation reports on business operations 	<ul style="list-style-type: none"> • Analyzing the achieved status of requests from the persons concerned • Understanding major needs for business improvements • Understanding at the system level, the evaluation of the effect on business presented by the representative of user departments
20 Evaluation of Investment Effect including Effect on the Business	20-1 Evaluation of investment effect including effect on the business	<p>Evaluate the performance of business operations with the new system, in terms of the effect of the investment and effect on the business. Then, document and report the evaluation results.</p>	<ul style="list-style-type: none"> • Collection, analysis, and evaluation of data 	<ul style="list-style-type: none"> • Setting improvement targets and performance indicators • Performing an effect analysis with appropriate indicators • Give appropriate feedback for planning the next business model and the next systems architecture
21 Problem Identification and Change Analysis with Regard to Maintenance	21-1 Analysis of problem reporting and change requests	<p>Analyze reported problems and change requests concerning possible impacts on organizations, the existing system, and the interfacing systems. Then, reproduce and verify the problems:</p> <ul style="list-style-type: none"> • Type: correction; improvement; prevention; adaptation to a new environment; etc. • Scope: amount of change; cost for change; time required for change; etc. • Severity: impacts on performance, safety, security, etc. 	<ul style="list-style-type: none"> • Maintenance • Software maintenance agreements • Configuration management 	<ul style="list-style-type: none"> • Creating a maintenance plan suitable for users' needs • Identifying the scope of impact on business that will be caused by performing maintenance work

Major category	Minor category	Outline	Required knowledge	Required skills
	21-2 Preparing options for implementing changes and obtaining approval for a selected one	Based on the analysis, create and document options for implementing the change. Obtain approval for the selected option as specified by the contract.	<ul style="list-style-type: none"> • System maintenance procedures • Software change management • Software maintenance • Maintenance contracts 	<ul style="list-style-type: none"> • Developing solutions to problems that may be detected during maintenance work • Negotiating with contractors • Determining the necessity of maintenance • Scheduling maintenance work

- Notes
- 1) Here, a life cycle model means a development model.
 - 2) The term “a software item” refers to an individual component that is part of an entire software program, such as an OS, a database program, a communication program, or an application program. These items are often managed in further segmented forms.
 - 3) The term “qualification requirements” refers to standards and criteria for determining whether a system or software to be developed can be used.
 - 4) The term “audit” means that an authorized, independent third party evaluates whether deliverables conform to requirements (especially to contracts).

[Embedded System]

Major category	Minor category	Outline	Required knowledge	Required skills
1 Analysis of Functional Requirements and Determination of Functional Specifications	1-1 Analysis of the functional requirements of a system to be developed	Analyze environmental conditions and functional requirements for operating an embedded system to be developed. Then, reflect the results in the system requirements specifications.	<ul style="list-style-type: none"> • How to proceed with a project • Basics of creating system requirements specifications • The target embedded system • System analysis techniques • Systems architectures, hardware, and software 	<ul style="list-style-type: none"> • Coordinating related in-house departments • Defining system requirements • Creating system requirements specifications
	1-2 Related technologies	Investigate and analyze regulations and trends in technologies (including advanced technologies such as IoT, big data, and AI) that will be necessary for the embedded system to be developed. In addition, clarify what technologies will need to be procured externally by evaluating relations with the company's own technologies.	<ul style="list-style-type: none"> • Related technologies • Related regulations • Technology trends (including advanced technologies such as IoT, big data, and AI) • Acquisition of technologies 	<ul style="list-style-type: none"> • Analyzing element technologies that constitute an embedded system, and planning measures to be taken for the related regulations • Proposing how to optimally acquire related technologies • Projecting and evaluating the issues and effects of external procurement
	1-3 Analysis of quality requirements	Analyze the quality requirements for the embedded system to be developed. Then, reflect the results in the system requirements specifications.	<ul style="list-style-type: none"> • System quality characteristics • Elements of quality requirements such as reliability, usability, functionality, responsiveness, and maintainability 	<ul style="list-style-type: none"> • Analyzing the requirements of quality characteristics
	1-4 Design of the development process	Select an appropriate development model according to the characteristics of the embedded system to be developed. Then, design the development process.	<ul style="list-style-type: none"> • Development models • Design of each process in a system life cycle 	<ul style="list-style-type: none"> • Analyzing and evaluating the advantages and disadvantages of various development models according to the characteristics of an embedded system • Designing each process in a system life cycle
	1-5 Cost-optimized design	Set target costs for the embedded system to be developed, and then allocate them.	<ul style="list-style-type: none"> • Cost estimation techniques • Cost management 	<ul style="list-style-type: none"> • Estimating costs for an embedded system appropriately, and setting target costs • Appropriately allocating the target costs to each manufacturing process
	1-6 Design for performance	Based on the results of analyzing the requirements for the embedded system to be developed, prepare a basic design for achieving the required performance.	<ul style="list-style-type: none"> • Design techniques for high reliability • Design techniques for safety • Performance evaluation techniques 	<ul style="list-style-type: none"> • Proposing an embedded system configuration that meets required functions and quality performance
	1-7 Organization of functional specifications	Concerning the embedded system to be developed, organize its functional, environmental, and quality requirements into the system requirements specifications.	<ul style="list-style-type: none"> • System requirements specifications • Tools related to the creation and management of various documentation such as requirements specifications 	<ul style="list-style-type: none"> • Organizing functional requirements for an embedded system into the system requirements specifications

Major category	Minor category	Outline	Required knowledge	Required skills
2 Determination of Specifications of Hardware and Software Requirements to Meet the Functional Specifications	2-1 Trade-off between hardware and software	Analyze the advantages and disadvantages of using software against using hardware or programmable LSI as a means of achieving each functional requirement. Then, propose the best way.	<ul style="list-style-type: none"> • Software and hardware IPs (Intellectual Properties) to meet functional requirements • Trends in related technologies • Trends in various technical standards 	<ul style="list-style-type: none"> • Proposing various methods for achieving an embedded system • Analyzing and evaluating the advantages and disadvantages of using either software or hardware or programmable LSI in order to achieve functional requirements
	2-2 Design by functional decomposition	Based on the external design results of the embedded system to be developed, perform functional decomposition by considering functional components such as process scale, interfaces, strength, and the degree of functional coupling.	<ul style="list-style-type: none"> • External design • Analysis of the coupling strength of components that constitute a function • Design and analysis of interfaces between functions • Analysis of the degree of functional coupling 	<ul style="list-style-type: none"> • Performing functional decomposition in an appropriate manner • Analyzing the degree of functional coupling
	2-3 Allocation of functions to system components	Based on the results of the functional decomposition design, allocate functions to system components.	<ul style="list-style-type: none"> • Techniques for functional decomposition 	<ul style="list-style-type: none"> • Optimally allocating functions to system components
	2-4 Definition of interfaces between devices	Based on the results of the functional decomposition design, define interfaces between the devices composing the system, and then reflect them in the specifications.	<ul style="list-style-type: none"> • Criteria of functional decomposition • Various interfaces • Design of interfaces 	<ul style="list-style-type: none"> • Defining the best interfaces between devices
	2-5 Design of the systems architecture	Based on the knowledge of data flows and user interfaces, design the best systems architecture for achieving the embedded system to be developed.	<ul style="list-style-type: none"> • How to configure a system • Distributed systems • Various techniques for analyzing systems 	<ul style="list-style-type: none"> • Proposing various architectures that allow systems to be achieved • Analyzing and evaluating various architectures that allow systems to be achieved, as well as advantages and disadvantages of each of the architectures
	2-6 Reliability design	According to the level required for the embedded system to be developed, perform a reliability design and organize the results into requirements for each of the relevant manufacturing processes.	<ul style="list-style-type: none"> • Design techniques for high reliability • Quality management 	<ul style="list-style-type: none"> • Designing at the level appropriate for the required reliability of a system • In accordance with the required reliability level of the system, allocating reliability requirements to each of the manufacturing processes of a system
	2-7 Design for ease of maintenance	Study maintenance after market entry, and design the functionality of the embedded system considering maintainability.	<ul style="list-style-type: none"> • Theory on maintainability • Ease of maintenance 	<ul style="list-style-type: none"> • Determining a way of maintenance according to a system specification environment • Designing a function suitable for a desired maintenance method
	2-8 Selecting Real-time OS	Select an appropriate real-time OS, and provide guidance on its use.	<ul style="list-style-type: none"> • Real-time OSs • How to use real-time OSs 	<ul style="list-style-type: none"> • Selecting and using the best real-time OSs while being familiar with their characteristics

Major category	Minor category	Outline	Required knowledge	Required skills
	2-9 Creating specifications of software and hardware requirements	Based on the results of the trade-off between hardware and software, organize the software requirements and the hardware requirements into their respective specifications.	<ul style="list-style-type: none"> • Software requirements specifications • Hardware requirements specifications • How to describe requirements specifications 	<ul style="list-style-type: none"> • Organizing the functional requirements of software into software requirements specifications • Organizing the functional requirements of hardware into hardware requirements specifications
3 Decision of development method according to the embedded system	3-1 Model based system, process model design, object-oriented model design	Based on the features of the embedded system, decide an optimal development method.	<ul style="list-style-type: none"> • Model based design • Process model design • Object-oriented model design 	<ul style="list-style-type: none"> • Select and decide an optimal development method according to the characteristics of a system to be developed.
4 Use of Versatile Modules	4-1 Modular design	With the aim of making the software versatile, provide guidance on its design from the viewpoints of module design and object-oriented programming.	<ul style="list-style-type: none"> • Modular design • Partitioning of software into components • Related IPs (Intellectual Properties) of software • Object-oriented programming 	<ul style="list-style-type: none"> • Providing guidance on modular design • Providing guidance on object-oriented programming
	4-2 Reuse	Provide guidance on the software design from the viewpoint of reusing and externally procuring software assets.	<ul style="list-style-type: none"> • Partition of software into components • Trends in the partitioning of software into components 	<ul style="list-style-type: none"> • Providing guidance on the partitioning of software into components • Judging the validity of using software components
	4-3 Configuration management	Perform configuration management such as managing the change history of deliverables.	<ul style="list-style-type: none"> • Software configuration management • Version control 	<ul style="list-style-type: none"> • Managing configuration management processes

**■ Systems Architect Examination (Level 4)
Syllabus (Version 4.1)**

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