# System Components

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April 15, 2023

# The Course Outline

# Course Outline

- **Course Title:** Preparation course for FE examination
- **Intended Participants:** University Students who are going to take ITPEC examinations
- **Course Duration:** 60 hours

# The Lecture Plan

# Lecture Plan: Morning Exam, Sec 2-Computer System, Chapter 2-System Components

| Time | Learning Points/Keywor | Explanation Points | Method | Level | Note |
|---|---|---|---|---|---|
| 10 minutes | System configuration | Parallel processing, Client/server processing, Transaction processing, Interactive processing | Verbal Explanation | **High** | |
| | | Dual system, Duplex system, Cluster, Multiprocessor system, Load sharing system | | | |
| | | Backup site, Hot site / Hot standby, Warm site / Warm standby, Cold site / Cold standby, Primary system | | | |
| | | Secondary system (backup system), Tight coupling, Loose coupling, Peer to peer | | | |
| | | Grid computing, Massively parallel | | | |
| | | Three-layer client/server system (presentation layer, function layer, and database access layer) | | | |
| | | Client, Server, Thin client system, RPC (Remote Procedure Call), Web browser, Web server | | | |
| | | RAID1, RAID2, RAID3, RAID4, RAID5, RAID6, Striping, Mirroring, Parity | | | |
| | | Fault, Fault tolerant system, Fault avoidance system, Fail safe, Fail soft, Foolproof, NAS | | | |
| 10 minutes | System evaluation indexe | Response time, RASIS, Throughput, Benchmark, TPC, SPECint, SPECfp | Verbal Explanation | **High** | |
| | or indicators | Monitoring, Sizing, Bath tub curve | | | |

# Objectives

## 2.1 Understand System configuration***

- Understand the processing modes, usage, and application areas of systems, and apply them to associated matters.
- Understand the types and characteristics of typical system configurations, and apply them to associated matters.
- Understand the characteristics and configurations of client/server systems.
- Understand the concept of reliability design of systems.

# Keywords

## 2.1 Understand System configuration***

- Parallel processing, Client/server processing, Transaction processing, Interactive processing, Dual system, Duplex system, Cluster, Multiprocessor system, Load sharing system, Backup site, Hot site / Hot standby, Warm site / Warm standby, Cold site / Cold standby, Primary system (currently used system), Secondary system (backup system), Tight coupling, Loose coupling, Peer to peer, Grid computing, Massively parallel, Three-layer client/server system (presentation layer, function layer, and database access layer), Client, Server, Thin client system, RPC (Remote Procedure Call), Web browser, Web server, RAID0, RAID1, RAID2 ,RAID3, RAID4, RAID5, RAID6, Striping, Mirroring, Parity, Fault, Fault tolerant system, Fault avoidance system, Fail safe, Fail soft, Foolproof, NAS

# Objectives

## 2.2 Understand System evaluation indexes or indicators***

- Understand the concept for measurement of system performance, reliability, and economical efficiency, as well as the concept of performance indicators and capacity planning, and apply them to associated matters.

# Keywords

## 2.2 Understand System evaluation indexes or indicators***

- Response time, RASIS, Throughput, Benchmark, TPC, SPECint, SPECfp, Monitoring, Sizing, Bath tub curve

# Analyzation

# Analyzation

- Analyzed 25 questions
- Covered the most recent years
  - 2021 Q1 Exam
  - 2021 Q2 Exam
  - 2020 Q2 Exam

# Questions

# Question 1

Q1. (q2-25) On what basis are the configurations of RAID 1 to 5 classified?

a. Access performance to hard disk drives used in each configuration
b. Differences in the interface connected to the computer
c. Combinations of where and how both data and redundant bits are stored
d. Guaranteed reliability that is measured in MTBF

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Theme: System Components, Category: FE

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c. Combinations of where and how both data and redundant bits are stored
d. Guaranteed reliability that is measured in MTBF

# Question 1: Answer Explanation: Slide I

- RAID (Redundant Array of Inexpensive Disks) is a technology for improving the speed and reliability of access by consolidating multiple hard disk drives into a single logical disk. The access speed is improved by distributing and storing data in multiple disks and enabling access in parallel (striping). Furthermore, reliability is improved through mirroring of the disk and also by securing data for error correction. Depending on the unit of striping and the method of securing reliability, RAID is classified into six types, namely RAID0 through RAID5.
  Therefore, c) is the correct answer.
- RAID0: This is a method that performs only striping. Therefore, there is no improvement in reliability.
- RAID1: This is a method that performs only disk mirroring.

# Question 1: Answer Explanation: Slide II

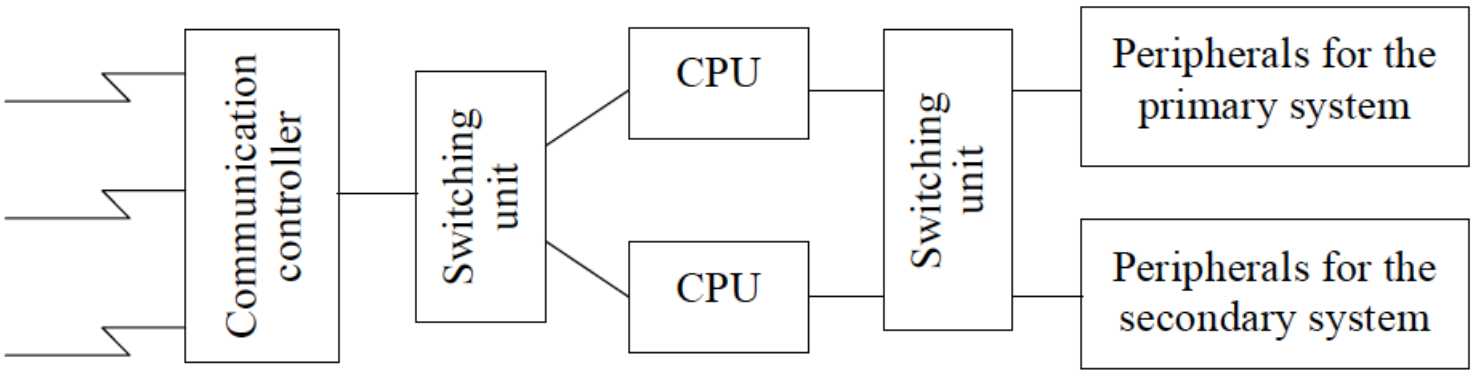
- RAID2: This is a method by which striping is performed at the bit level, data for error correction is secured with a dedicated (fixed) disk, and error correction is performed by the hamming method, which is currently still not in practical use.
- RAID3: This is a method by which striping is performed at the bit level, data for error correction is secured with a dedicated (fixed) disk, and error correction is performed by the parity method. By using the parity method instead of the hamming method, the redundant data (data for error correction) can be reduced in comparison with RAID2, which makes this a feasible method. Initially, parity was performed at the bit level, but in practice it is performed at the byte level.
- RAID4: This is a method by which striping is performed at the block level, data for error correction is secured with a dedicated (fixed) disk, and error correction is performed with the parity method, which is currently still not in practical use.

# Question 1: Answer Explanation: Slide III

- RAID5: Striping is performed at the block level, and data for error correction is distributed and deployed on each disk. By the distribution and deployment of data for error correction, access to the disk in which the data for error correction is stored, the flaw of RAID4 where access speed is reduced by a bottleneck is improved. RAID5 has been put to practical use together with RAID1.

# Question 2

Q2. (q2-26) A system configuration includes two systems as shown in the figure below in which one system performs on-line processing as the primary system, and the other system is on standby as the secondary system in case of a failure of the primary system. Normally, the secondary system performs batch processing. Which of the following indicates such a system configuration?




a. Simplex system
b. Dual system
c. Duplex system
d. Parallel processor system

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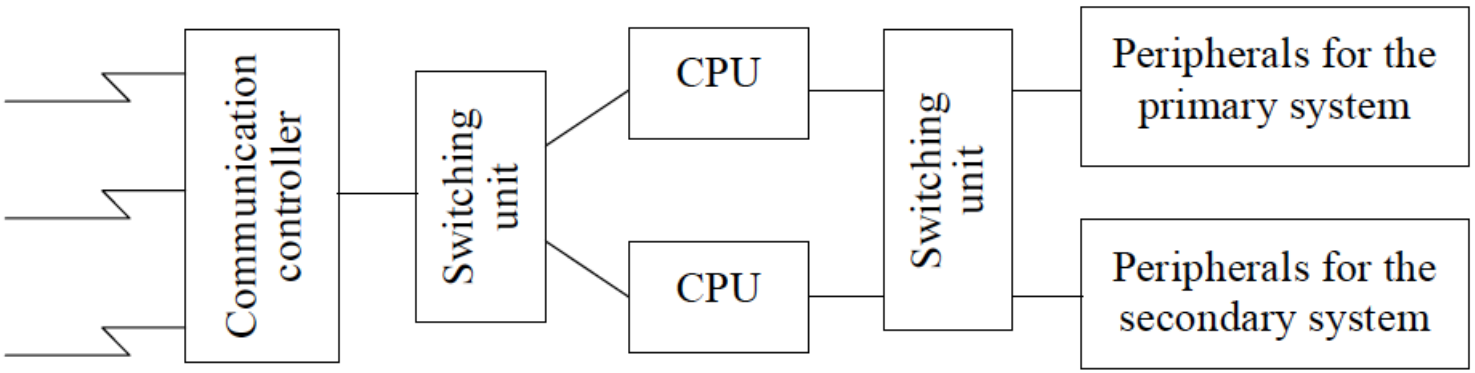


Theme: System Components, Category: FE

a. Simplex system
b. Dual system
c. Duplex system
d. Parallel processor system

# Question 2: Answer Explanation: Slide I

- A system configuration composed of two systems as shown in the figure in the question is the most common configuration of an on-line system called a **duplex system**. When the primary system that performs on-line processing breaks down, the processing is switched to the backup system and can be completed by losing only the switching time, which makes this a highly-reliable system. Therefore, c) is the correct answer.
- a) **Simplex system:** This is a simple system configuration without any redundancy. If any component breaks down, the entire system breaks down.

# Question 2: Answer Explanation: Slide II

- b) **Dual system:** This is a system in which two computers perform the same processing, and the processing results are collated at a fixed interval. Even if one computer breaks down, the processing continues with the other computer. This is a system that has a very high reliability with no loss resulting from a failure, but the cost is very high and the cost performance is low.
- d) **Parallel processor system:** This is a system composed of multiple processors. In the recent years, multiprocessor workstations with multiple (two to four) processors installed have even appeared, but a parallel processor system indicates a system with a relatively large number of processors, such as a super computer.

# Question 3

Q3. (q2-27) Which of the following is an appropriate description concerning a hot standby system?

a. A standby system monitors whether or not the primary system is running, and when it detects a breakdown in the primary system, it immediately takes over the processing of the primary system.

b. A standby system monitors the jobs that are entered into the primary system, and when a job with a large amount of data processing is entered, the standby system executes the job in place of the primary system.

c. The standby system monitors the load status of the primary system, and when an overload (overload status) in the primary system is detected, it takes over and performs the processing that resulted in the overload.

d. The standby system simultaneously executes the same processing as the primary system, and completes the processing if the primary system breaks down.

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# Question 3: Answer Explanation: Slide I

- A hot standby system is one of the techniques for improving reliability. A computer system is duplicated, the same application software as the primary (or currently used) system is also installed on the backup system which is left in a standby state, and as soon as a failure occurs in the primary system, the processing is switched to the backup system and continued. Since both the primary system and the backup system operate from the time normal operation starts, the reliability improves, but a certain amount of cost is also involved. On the other hand, a system in which the backup system does not operate but is left in a standby state is called a cold standby system. Under these conditions, the cost is low in comparison with a hot standby system, but some time is taken up in switching the system, so the system stops during the switching time.
  Therefore, a) is appropriate.

# Question 3: Answer Explanation: Slide II

- b), c) In a hot standby system, the backup system operates when the primary system fails (breaks down).
- d) The backup system is in the standby state when the primary system is operating.

# Question 4

Q4. (q2-28) Which of the following is an appropriate characteristic of a client/server system?

a. It is a form of distributed processing in which the client and server work together to perform intended processing, and functions are divided based on the concept of services that are provided by the server.

b. A tightly coupled system configuration is adopted so that the client and server can have access to common data resources in coordination.

c. In response to the requests from many servers, the client simultaneously provides the services while it works in coordination with the servers, and controls access to the client resources from the servers.

d. The database installed on the client that provides the services can also be expanded flexibly according to the size of the system.

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# Question 4: Answer Explanation

- A client/server system is a distributed processing system in which a dedicated computer (server) that provides various services and another computer (client) that requests and uses a service operate in coordination while processing is shared over a network. There are various types of server such as a Web server, a mail server, and a database server.
  Therefore, a) is appropriate.
- b) A client/server system is a distributed processing system, and generally, the server accesses the data resources.
- c), d) A client is a computer that uses the service.

# Question 5

Q5. (q2-29) A client/server system is to be constructed. Which of the following is the activity that is reduced most effectively when client processing is performed by a browser instead of a dedicated application?

a. Maintenance of the client environment
b. Recovery from a server failure
c. Construction of databases
d. Creation and deletion of login accounts

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# Question 5: Answer Explanation: Slide I

- It is clear from a "client/server system using a browser" that the software for business operations are consolidated on the server, and the client only displays the screens via the browser. In a client/server system that does not use a browser, software for business operations is necessary for each client, and therefore, maintenance tasks such as version upgrade of the software for business operations must be performed for each client. However, when a browser is used and the software for business operations is consolidated on the server, maintenance needs to be performed only on the server, which reduces the maintenance activities on the client side.
  Therefore, a) is the correct answer.
- b) Recovery of the server is performed even in systems using a browser.
- c) Construction of a database is necessary, regardless of whether a browser is used or not.

# Question 5: Answer Explanation: Slide II

- d) When a browser is used, the maintenance management of login accounts may actually increase in order to prevent unauthorized use.

# Question 6

Q6. (q2-30) Which of the following is the technique that is used to improve file access speed by dividing the data of each file into fixed-size blocks, and distributing these blocks across multiple disks that can be accessed in parallel?

a. Disk at once
b. Disk cache
c. Disk striping
d. Disk mirroring

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b. Disk cache
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# Question 6: Answer Explanation: Slide I

- The sequential distribution of data that has been divided into fixed units (such as bits, bytes, or blocks) on multiple disk drives to enable parallel access is called **disk striping** as described in c).
  It is the fundamental technique for a disk array.
- a) **"Disk at once"** is a method for writing to a CD-R according to which no additions can be made once data has been written on it, regardless of the amount of written data. In contrast, the method by which data is written on separate tracks to enable additions to be made is called "track at once".

# Question 6: Answer Explanation: Slide II

- b) **Disk cache** is a buffer storage placed between the main memory and disk drive, which can be accessed at a higher speed than the disk. Data that has been accessed is retained in the disk cache and imported from there to main memory when the next access request is received. At this time, since the disk is not accessed, the apparent access time of the disk drive can be shortened. Two methods are available to implement this. In one method, software uses part of the main memory, and in the other method an external semiconductor memory in the form of hardware is used.
- d) **Disk mirroring** is a method of duplicating the same data on two disk drives. Even if one disk fails, the loss of data can be prevented by using the other disk, and processing can be continued.

# Question 7

Q7. (q2-31) Which of the following is an appropriate explanation of a fault tolerant system?

a. It is a system that retains the necessary functions of the overall system even when the system partially fails.

b. It is a system that is installed as a backup in a remote site in preparation for local disasters.

c. It is a system in which multiple processors are connected via a network so as to share the resources.

d. It is a system in which a single transaction is processed in parallel in multiple processors, and the results are compared.

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d. It is a system in which a single transaction is processed in parallel in multiple processors, and the results are compared.

# Question 7: Answer Explanation

- Fault tolerance is the ability to handle failures. A fault tolerant system is set up in consideration of accomplishment of a business operation even when the system partially fails.
  Therefore, a) is appropriate.
- b) This is a description concerning a backup site.
- c) This is a description concerning a (loosely coupled) multiprocessor system or cluster system.
- d) This is a description concerning a dual system.

# Question 8

Q8. (q2-32) Which of the following is appropriate as the concept of fail safe?

a. A system is always controlled in a safe state even when a failure occurs in the system.

b. When a problem occurs in the functions of a system, the system operation is continued by degrading its functionality rather than stopping immediately.

c. The reliability of the system is increased by preparing multiple components of the system that have a significant impact on reliability.

d. A system is designed so that a malfunction does not occur easily even if an unspecified number of users operate the system.

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# Question 8: Answer Explanation

- Fail safe is the concept of controlling a system in a predetermined safe state so as to prevent any risks as a result of a failure in the system. Therefore, the concept of a) is appropriate.
  This concept is adopted in systems such as traffic signal control, where a failure of the system poses a threat to life.
- b) This refers to degraded (fall back) operation, and a system that has this function is called a fail soft system.
- c) This is the concept of a redundant system, and is the basic concept of fault tolerance.
- d) In a system operated by an unspecified number of users, the entry of unexpected values and operating methods need to be given consideration. When such an unexpected operation is performed after a strict input check is conducted, the concept of making the occurrence of malfunctions unlikely is called a foolproof design.

# Question 9

Q9. (q2-33) Which of the following is a method of connecting auxiliary storage devices, such as a hard disk drive or a magnetic tape unit, in a high-speed dedicated network that is separated from the normal LAN?

a. DAFS
b. DAS
c. NAS
d. SAN

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# Question 9: Answer Explanation: Slide I

- The network to connect storage devices, such as a hard disk drive or a magnetic tape unit, separately from the normal LAN is called SAN (Storage Area Network) d). In the majority of the cases, this storage is configured by connecting one storage device with another through an optical fiber channel to form a network with a higher speed than the normal LAN.
  The meaning of the other terms is as follows:
- a) DAFS (Direct Access File System): This is a file sharing protocol focusing on high-speed data transfer that is applied in NAS described in c) below, which suppresses the CPU load and overheads by performing direct communication between applications without going through the OS.
- b) DAS (Direct Attached Storage): This is storage such as a disk array that is directly connected to the server.

# Question 9: Answer Explanation: Slide II

- c) NAS (Network Attached Storage): This is a product designed exclusively for storage that enables file transfer only by connecting directly to a network such as LAN.

# Question 10

Q10. (q2-34) Which of the following is an appropriate explanation of throughput?

a. It is the time that elapses after the loading of a job into a system until the complete acquisition of the result, and it is affected by the I/O speed and the overhead time.

b. It is the operating ratio of a job, and is calculated from "running time of the job ÷ operation time".

c. It is the maximum number of jobs that can be executed concurrently, and depends on the resources of the system that is used.

d. It is the number of jobs processed per unit time, and spooling is useful for the improvement of system throughput.

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# Question 10: Answer Explanation: Slide I

- Throughput is the processing amount per unit time, and "the number of jobs processed per unit time" described in d) corresponds to throughput. Generally, the maximum number of jobs that can be executed simultaneously is fixed, and therefore, each job is completed in the shortest possible time to improve throughput. On the other hand, spooling is a mechanism for removing the operating time of a low-speed peripheral device, such as a printer, from the execution time of a job, and by using this mechanism, the execution time of the job can be reduced. This is useful in improving throughput. Therefore, d) is the appropriate description.
- a) This is an explanation of the turnaround time. Turnaround time is a system performance evaluation indicator that is seen mostly in a batch processing system.
- b) Such an index is not common. It is in no way an explanation of throughput.

# Question 10: Answer Explanation: Slide II

- c) The description itself is correct, but it is not an explanation of throughput

# Question 11

Q11. (q2-35) Which of the following is an appropriate explanation concerning the benchmark used for performance evaluation of a computer?

a. TPC, which is a typical benchmark for on-line transaction processing, uses TPS as an objective performance scale but does not have a cost scale.

b. Performance benchmarks for an entire computer system include Dhrystone, Whetstone, Livermore Fortran Kernel, Linpack, and SPEC.

c. The execution of various types of benchmark tests for performance evaluation is useful in selecting the model to be installed because it enables the understanding of the characteristics of system performance.

d. The benchmark test is a general-purpose evaluation model, and its results can be widely applied to the evaluation of computer performance.

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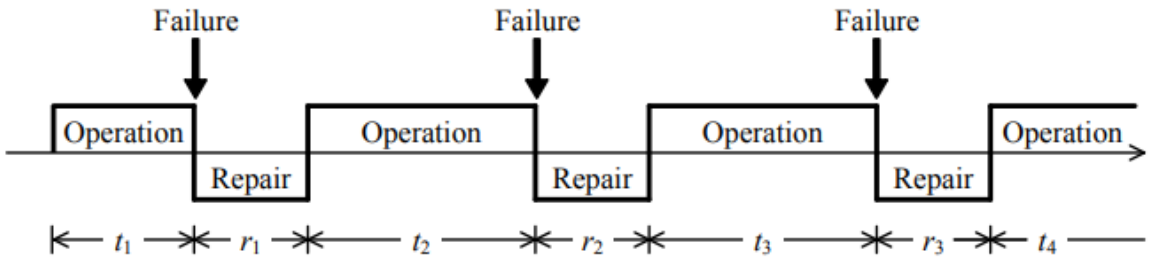
# Question 11: Answer Explanation: Slide I

- A benchmark test is used to compare and evaluate the performance of a computer by measuring the execution time of standard programs. Therefore, if various types of benchmark tests are performed, the characteristics of a system can be understood by using the results, which implies that the description "useful in selecting the model to be installed" provided in c) is appropriate. The other descriptions contain the errors described below:
- a) The results of the TPC benchmark are expressed in terms of performance value and cost performance, and a cost scale is used.
- b) For example, Dhrystone is used to measure a computer's performance of integer operations, and is not a benchmark test for evaluating the performance of the entire computer system.
- d) A benchmark test is used to evaluate a target with a specific purpose, and cannot be referred to as a general evaluation model.

# Question 12

Q12. (q2-36) When the system operations model is shown in the figure below, which of the following is the combination of expressions that represent the MTBF and MTTR of the system? Here, $t_i$ represents the system operating time, and $r_i$ represents the system repair time $(i = 1, 2, ..., n)$.




| | MTBF | MTTR |
|---|---|---|
| a) | $\frac{1}{n}\sum_{i=1}^{n} r_i$ | $\frac{1}{n}\sum_{i=1}^{n} t_i$ |
| b) | $\frac{1}{n}\sum_{i=1}^{n} t_i$ | $\frac{1}{n}\sum_{i=1}^{n} r_i$ |
| c) | $\frac{1}{n}\sum_{i=1}^{n} t_i$ | $\frac{1}{n}\sum_{i=1}^{n} (t_i + r_i)$ |
| d) | $\frac{1}{n}\sum_{i=1}^{n} (t_i + r_i)$ | $\frac{1}{n}\sum_{i=1}^{n} r_i$ |

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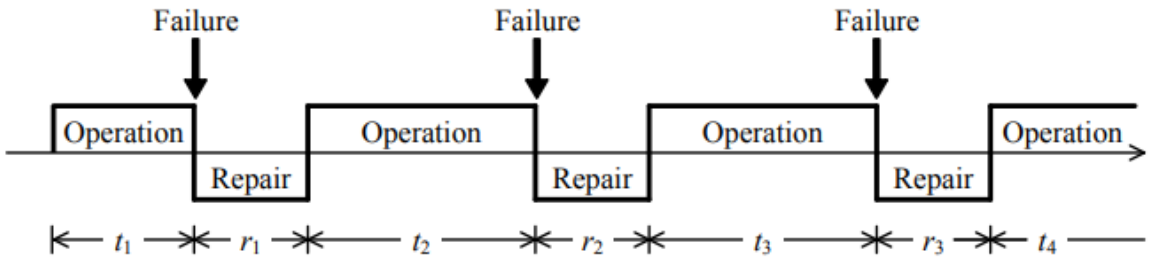


| | MTBF | MTTR |
|---|---|---|
| a) | $\frac{1}{n}\sum_{i=1}^{n} r_i$ | $\frac{1}{n}\sum_{i=1}^{n} t_i$ |
| b) | $\frac{1}{n}\sum_{i=1}^{n} t_i$ | $\frac{1}{n}\sum_{i=1}^{n} r_i$ |
| c) | $\frac{1}{n}\sum_{i=1}^{n} t_i$ | $\frac{1}{n}\sum_{i=1}^{n} (t_i + r_i)$ |
| d) | $\frac{1}{n}\sum_{i=1}^{n} (t_i + r_i)$ | $\frac{1}{n}\sum_{i=1}^{n} r_i$ |

- Option b)

# Question 13

Q13. (q2-37) Among indicators or indexes of RAS used for evaluating the level of system reliability, which of the following is a measure of availability?

a. $\frac{MTBF}{MTBF+MTTR}$
b. $MTBF + MTTR$
c. $MTBF$
d. $MTTR$

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a. $\frac{MTBF}{MTBF+MTTR}$
b. $MTBF + MTTR$
c. $MTBF$
d. $MTTR$

# Question 13: Answer Explanation

- RAS, a set of indexes or indicators representing the reliability of a system, is formed from the first letter of the words Reliability, Availability, and Serviceability.
- **Reliability:** This expresses how unlikely a failure is. It is expressed by using MTBF (Mean Time Between Failures).
- **Availability:** This expresses the possibility of use when the system is needed. It is expressed by using the availability ( $\frac{MTBF}{MTBF+MTTR}$ ).
- **Serviceability:** This expresses the ease of repair. It is expressed by using MTTR (Mean Time To Repair).
- Therefore, a) is the correct answer. b), c), and d). Even when the total operating time (MTBF+MTTR), MTBF, and MTTR are known, how long normal operation would continue cannot be determined.

# Question 14

Q14. (q2-38) Which of the following causes an increase in availability?

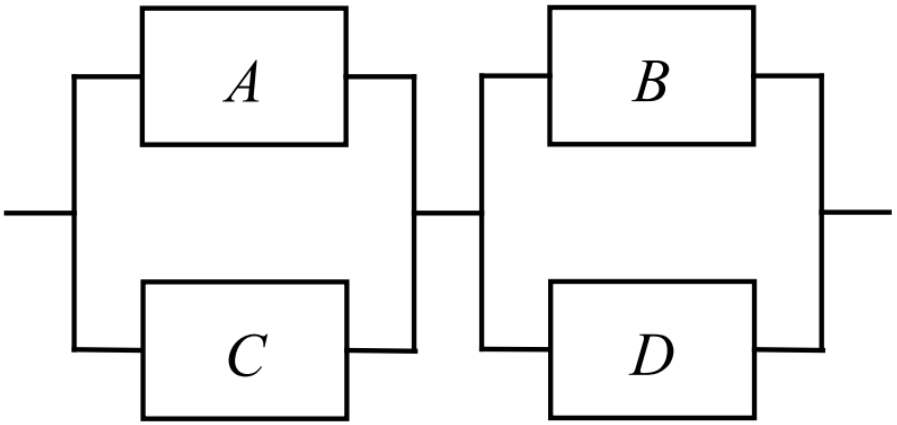
a. Both MTBF and MTTR are doubled.
b. Both MTBF and MTTR are halved.
c. MTBF is doubled and MTTR is halved.
d. MTBF is halved and MTTR is doubled.

Q14. (q2-38) Which of the following causes an increase in availability?
Theme: System Components, Category: FE

a. Both MTBF and MTTR are doubled.
b. Both MTBF and MTTR are halved.
c. MTBF is doubled and MTTR is halved.
d. MTBF is halved and MTTR is doubled.

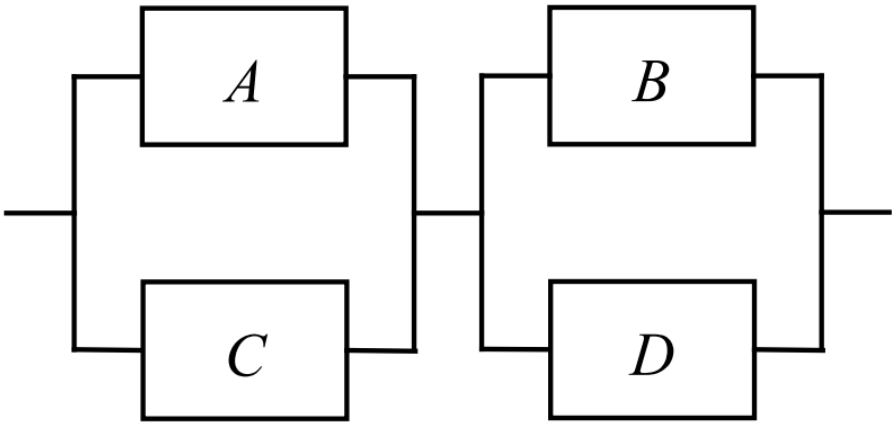
# Question 15

Q15. (q2-39) Which of the following is the closest to the availability of an entire system that is composed of the four devices A to D? Here, the availability of devices A and C is 0.9 and the availability of devices B and D is 0.8. Furthermore, a section in which devices are connected in parallel is available when either of the devices is operating (available).




a. 0.72
b. 0.92
c. 0.93
d. 0.95

Q15. (q2-39) Which of the following is the closest to the availability of an entire system that is composed of the four devices A to D? Here, the availability of devices A and C is 0.9 and the availability of devices B and D is 0.8. Furthermore, a section in which devices are connected in parallel is available when either of the devices is operating (available).

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a. 0.72
b. 0.92
c. 0.93
d. 0.95

# Question 15: Answer Explanation: Slide I

The expression for calculating the availability of a system is different when devices are connected in parallel and when devices are connected in series.
When devices are connected in parallel:
1 - (1 - Availability of device A) $\times$ (1 - Availability of device B)
When devices are connected in series:
Availability of device A $\times$ Availability of device B
The devices A and C, and B and D are connected in parallel, and these two sections are connected in series.
Each of the sections in which devices are connected in parallel is available when either of the two devices is operating, that is, this section operates as long as both devices have not broken down.
In consideration of the conditions of the question, the availability of each of the parallel sections is expressed as follows:
Section in which A and C are connected in parallel:
1 - (1 - 0.9) $\times$ (1 - 0.9) = 1 - 0.01 = 0.99

# Question 15: Answer Explanation: Slide II

Section in which B and D are connected in parallel:
1 - (1 - 0.8) $\times$ (1 - 0.8) = 1 - 0.04 = 0.96
Since these two sections are connected in series, the availability of the entire system is:
0.99 $\times$ 0.96 = 0.9504
Therefore, the closest is d) 0.95.

# Question 16

Q16. (q2-40) Two printers have an availability of 0.7 and 0.6 respectively. Which of the following is the probability that one of these printers is available and the other is broken down? Here, the operational state of the two printers is independent, and factors other than the printers are ignored.

a. 0.18
b. 0.28
c. 0.42
d. 0.46

Q16. (q2-40) Two printers have an availability of 0.7 and 0.6 respectively. Which of the following is the probability that one of these printers is available and the other is broken down? Here, the operational state of the two printers is independent, and factors other than the printers are ignored.
Theme: System Components, Category: FE

a. 0.18
b. 0.28
c. 0.42
d. 0.46

# Question 16: Answer Explanation: Slide I

When the operational state of two printers is expressed by $\alpha$ for an available state and $\beta$ for an unavailable state, the following four cases are assumed:
(1) Printer with an availability of 0.7 $\alpha$
Printer with an availability of 0.6 $\alpha$
(2) Printer with an availability of 0.7 $\alpha$
Printer with an availability of 0.6 $\beta$
(3) Printer with an availability of 0.7 $\beta$
Printer with an availability of 0.6 $\alpha$
(4) Printer with an availability of 0.7 $\beta$
Printer with an availability of 0.6 $\beta$
The cases in which either of the two printers is available and the other is unavailable are cases (2) and (3).
Since the probability of a failure is (1 - availability), the probability of each of the above cases is calculated as below:

# Question 16: Answer Explanation: Slide II

(2) $0.7 \times (1 - 0.6) = 0.28$
(3) $(1 - 0.7) \times 0.6 = 0.18$
The probability of (2) or (3) is calculated by adding the two cases, which is $0.28 + 0.18 = 0.46$.
Therefore, d) is the correct answer.

# Question 17

Q17. (q2-41) In an online system, when an average of 600,000 instructions and two file accesses per transaction need executing, what is the average processing time (in milliseconds) for one transaction on a computer that has a CPU performance of 30 MIPS? Here, the average file access time is 30 milliseconds, and no other processing than this transaction occurs.

a. 8
b. 40
c. 62
d. 80

Q17. (q2-41) In an online system, when an average of 600,000 instructions and two file accesses per transaction need executing, what is the average processing time (in milliseconds) for one transaction on a computer that has a CPU performance of 30 MIPS? Here, the average file access time is 30 milliseconds, and no other processing than this transaction occurs.
Theme: System Components, Category: FE

a. 8
b. 40
c. 62
d. 80

# Question 17: Answer Explanation: Slide I

According to the conditions described in the question, the processing time of this transaction is the sum total of the time of execution of 600,000 instructions and the time required for two file accesses. First, since the average access time of the disk is 30 milliseconds, the time required for two file accesses is calculated as $30 \times 2 = 60$ milliseconds. Next, since the CPU performance is 30 MIPS, that is, 30 million instructions can be executed in one second, the time required for executing 600,000 instructions is

600,000 $\div$ 30 million

$= 1 / 50$ seconds

$= 20$ milliseconds.

Therefore, the average processing time of a transaction is $20 + 60 = 80$ milliseconds, which means that d) is the correct answer.

# Question 18

Q18. (2021 A FE AM-q15) Which of the following is the appropriate description of RAID 5?

a. Bit-level striping with a dedicated parity disk
b. Block-level striping with a dedicated parity disk
c. Block-level striping with distributed parity disks
d. Byte-level striping with a dedicated parity disk

Q18. (2021 A FE AM-q15) Which of the following is the appropriate description of RAID 5?

Theme: System Components, Category: FE

a. Bit-level striping with a dedicated parity disk
b. Block-level striping with a dedicated parity disk
c. Block-level striping with distributed parity disks
d. Byte-level striping with a dedicated parity disk

# Question 19

Q19. (2021 A FE AM-q16) In the time-chart of a system shown below, the shaded parts represent the normal working hours of the system, and the white parts represent the time when the system is not available due to failure. The numbers inside each part indicate the start and end hours of each state. Which of the following is the availability of the system?

| | | | | | | |
|---|---|---|---|---|---|---|
| 0~60 | 60~70 | 70~145 | 145~150 | 150~240 | 240~255 | 255~300 |

a. 0.10
b. 0.82
c. 0.90
d. 0.98

Q19. (2021 A FE AM-q16) In the time-chart of a system shown below, the shaded parts represent the normal working hours of the system, and the white parts represent the time when the system is not available due to failure. The numbers inside each part indicate the start and end hours of each state. Which of the following is the availability of the system?

| 0~60 | 60~70 | 70~145 | 145~150 | 150~240 | 240~255 | 255~300 |
|---|---|---|---|---|---|---|

a. 0.10
b. 0.82
c. 0.90
d. 0.98

# Question 20

Q20. (2021 S FE AM-q14) Which of the following is an appropriate description of USB 3.0?

a. It is a serial interface that adopts isochronous transmission that is suitable for audio or video, and has a broadcast transmission mode.

b. It is a serial interface that has a data transmission mode of 5 Gbit/s that is called super speed.

c. It is a serialized ATA specification that connects a PC to a peripheral device.

d. It is an interface that uses four (4) pairs of signal lines transmitting two (2) bits of information in one (1) clock and has a maximum throughput of 1 Gbit/s.

Q20. (2021 S FE AM-q14) Which of the following is an appropriate description of USB 3.0?

Theme: System Components, Category: FE

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# Question 21

Q21. (2021 S FE AM-q15) Which of the following is the RAID level where the entire stored data is lost when one of the multi-disks is damaged?

a. RAID 0
b. RAID 1
c. RAID 5
d. RAID 6

Q21. (2021 S FE AM-q15) Which of the following is the RAID level where the entire stored data is lost when one of the multi-disks is damaged?
Theme: System Components, Category: FE

a. RAID 0
b. RAID 1
c. RAID 5
d. RAID 6

# Question 22

Q22. (2021 S FE AM-q16) Which of the following is the approximate availability of a system in percentage when the MTBF is 30 days and the MTTR is 6 hours?

a. 0.83
b. 83.33
c. 98.36
d. 99.17

Q22. (2021 S FE AM-q16) Which of the following is the approximate availability of a system in percentage when the MTBF is 30 days and the MTTR is 6 hours?

Theme: System Components, Category: FE

a. 0.83
b. 83.33
c. 98.36
d. 99.17

# Question 23

Q23. (2020 S FE AM-q12) Which one of the following serial transmission methods is used in asynchronous data communication?

a. $I^2C$
b. PCI Express
c. SPI
d. UART

Q23. (2020 S FE AM-q12) Which one of the following serial transmission methods is used in asynchronous data communication?
Theme: System Components, Category: FE

a. $I^2C$
b. PCI Express
c. SPI
d. UART

# Question 24

Q24. (2020 S FE AM-q13) As a backup system configuration, which of the following is an appropriate description of a hot site?

a. A shared site is prepared, and at the time of the occurrence of a failure, the backed-up data and program are loaded to recover the system, and business operations are resumed.

b. A site is operated as a standby site, the data and programs are updated at all times via a network, and the business operation is resumed immediately when a failure occurs.

c. A spare site is secured beforehand, and at the time of the occurrence of a failure, the required hardware and the backed-up data and program are loaded to recover the system, and the business operation is resumed.

d. Hardware is prepared at a spare site, and the periodically backed-up data and program are loaded and stored. At the time of occurrence of a failure, the system is restored by making use of these stored entities, and the business operation is resumed.

Q24. (2020 S FE AM-q13) As a backup system configuration, which of the following is an appropriate description of a hot site?
Theme: System Components, Category: FE

a. A shared site is prepared, and at the time of the occurrence of a failure, the backed-up data and program are loaded to recover the system, and business operations are resumed.

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d. Hardware is prepared at a spare site, and the periodically backed-up data and program are loaded and stored. At the time of occurrence of a failure, the system is restored by making use of these stored entities, and the business operation is resumed.

# Question 25

Q25. (2020 S FE AM-q14) A RAID 6 server is configured with six hard disk drives, and each drive's capacity is one TB. What is the maximum total data storage capacity in TB? Here, spare disks are not used.

a. 3
b. 4
c. 5
d. 6

Q25. (2020 S FE AM-q14) A RAID 6 server is configured with six hard disk drives, and each drive's capacity is one TB. What is the maximum total data storage capacity in TB? Here, spare disks are not used.
Theme: System Components, Category: FE

a. 3
b. 4
c. 5
d. 6

# Any Questions?

# References

 IT Fundamentals (New FE Textbook Vol. 1)