

Undergraduate Programme
Department of Computer Science and Mathematics
Semester 2 Year 2019

FINAL EXAMINATION PAPER

ITC333 DISTRIBUTED SYSTEMS TECHNOLOGY

Important Instructions to Students:

1. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes reading time** (during this time, you are not allowed to write with pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. **This Final Course Examination Paper is worth 100 marks contributes 50% of the total course assessments.**
6. This paper contains two (2) sections A and B. In section B you need to answer **only 2** questions.
7. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
8. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-8	Open Ended Questions	80	120 minutes
B	1-3	Essay Open	20	60 minutes
		TOTAL	100	180 Minutes

Section A: Open Ended Questions

(80 marks)

Instructions:

Write your answers in the answer booklet.

Answer all the questions

Question 1

(10 marks)

- a) Explain what is a distributed system? (1 mark)

- b) Managing group membership can be exceedingly difficult, if only for reasons of admission control. To explain, we make a distinction between open and closed groups. Describe open and closed groups. (1 mark)

- c) In an overlay network, each node in the collection communicates only with other nodes in the system, its neighbors. The set of neighbors may be dynamic, or may even be known only implicitly. (1 mark)

- d) Explain 4 pitfalls when developing a distributive systems. (2 marks)

- e) List two computing systems. (1 mark)

- f) What do we mean by "Openness of distributed systems? Describe two features. (1 mark)

- g) Many developers of modern distributed systems easily use the adjective “scalable” without making clear why their system actually scales. List 3 components of scalability. (3 marks)

Question 2

(10 marks)

- a) Mention 3 types of distributive systems. (1.5 marks)
- b) List 3 characteristics of an architectural style in terms of component. (1.5 marks)
- c) Four architectural styles have by now been identified, of which the most important ones for distributed systems are: (2 marks)
- d) List and describe the Five layers in Grid Computing (2.5 marks)
- e) Explain the other operations available in RESTful architectures apart from PUT and GET. (1 marks)
- f) The Application Layering is found in many distributed information systems, using traditional database technology and accompanying applications. Mention the three-layered view. (1.5 marks)

Question 3

(10 marks)

List of missing words:

(2.5 marks)

Thread, Processor, Process, Thread context, process context

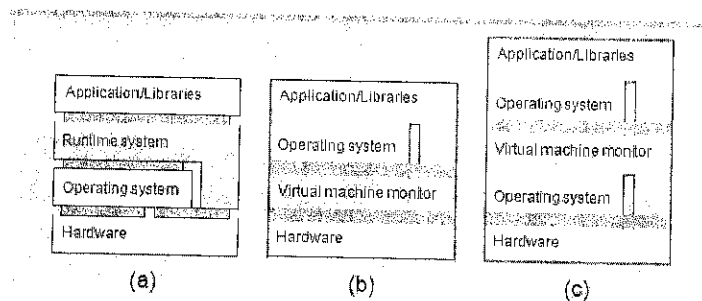
- a) A _____ provides a set of instructions along with the capability of automatically executing a series of those instructions.
- b) A _____ is a minimal software processor in whose context a series of instructions can be executed. Saving a thread context implies stopping the current execution and saving all the data needed to continue the execution at a later stage.
- c) A _____ is a software processor in whose context one or more threads may be executed. Executing a thread, means executing a series of instructions in the context of that thread.

- d) The minimal collection of values stored in the registers of a processor used for the execution of a series of instructions (e.g., stack pointer, addressing registers, program counter) is called _____.
- e) The minimal collection of values stored in registers and memory, used for the execution of a series of instructions (i.e., processor context, state) is called _____.

f) List 3 reasons why we use threads? (1.5 marks)

g) List 3 reasons why Virtualization is important? (1.5 marks)

h) Look at the diagram below and explain the three types of virtualization in (a), (b) and (c). (1.5 marks)



i) Mention the three types of cloud services. (1.5 marks)

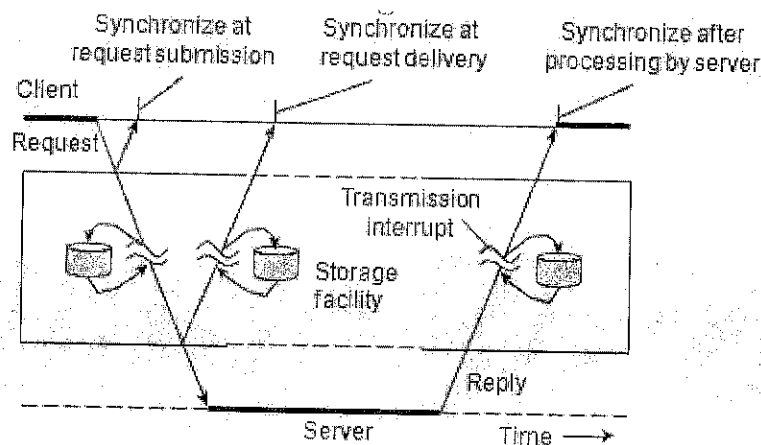
j) Most services are tied to a specific port. Write the port number of ftp, smtp and www. (1.5 marks)

Type	Port Number	Description
ftp-data	20	File Transfer [Default Data]
ftp		File Transfer [Control]
telnet	23	Telnet
smtp		Simple Mail Transfer
www		Web (HTTP)

Question 4

(10 marks)

- a. In the OSI model, communication is divided into seven levels or layers. The first layer from the Network cables is Physical layer. List down the other six layers accordingly. (6 marks)
1. Physical layer
- b. There are different types of communication. In the diagram above, the communication server does transient and persistent communication. Describe them. (2 marks)



- c. Unlike structured peer-to-peer systems, looking up data cannot follow a predetermined route when lists of neighbors are constructed in an ad hoc fashion. Explain the term flooding and random walk. (2 marks)

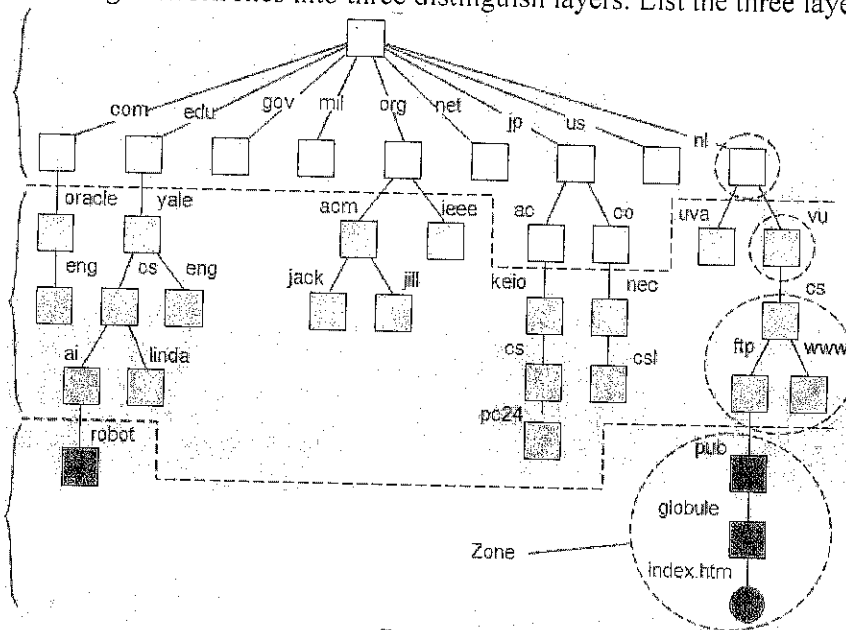
Question 5

(10 marks)

- a) In a distributed system, the implementation of a naming system is itself often distributed across multiple machines. How this distribution is done plays a key role in the efficiency and scalability of the naming system. Explain what is a name in a distributed system? What is an entity? Give examples. (3 marks)

- b) In addition to addresses, there are other types of names that deserve special treatment, such as names that are used to uniquely identify an entity. A true **identifier** is a name that has the following properties. [Wieringa and de Jonge, 1995]:
List 3 Characteristics of an identifier. (3 marks)

- c) In the Name-space implementation example below, shows the partitioning of the DNS name space, including network files into three distinguish layers. List the three layers. (3 marks)

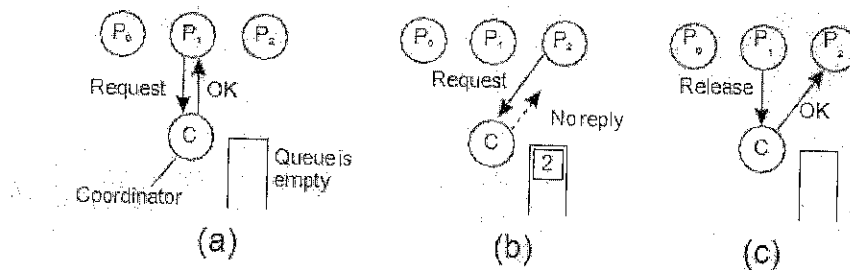


- d) What is an ARP? (1 mark)

Question 6

(10 marks)

- a) While communication is important, it is not the entire story. Closely related is how processes cooperate and synchronize with one another. Cooperation is partly supported by means of naming, which allows processes to at least share resources, or entities in general. We mainly concentrate on how processes can synchronize and coordinate their actions. Explain the terms Synchronization and coordination. (2 marks)
- b) Define Staleness deviation? (1 mark)
- c) Describe Sequential consistency? (1 mark)
- d) Different techniques can be applied in-order to propagate updates. Explain what it means. (1 mark)
- e) Mention the two primary reasons for replicating data. (2 marks)
- f) Discuss the centralized algorithm as in figures (a), (b) and (c) below. (3 marks)



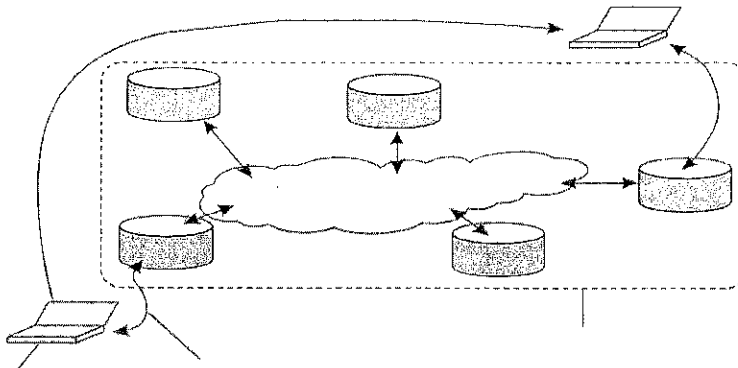
Question 7

(10 marks)

- a) To keep replicas consistent, we generally need to ensure that all conflicting operations are done in the same order everywhere. Explain the conflict read-write and write-write conflict. (2 marks)
- b) We can actually talk about the degree of consistency, however replicas may differ in a number ways. List two ways replicas are different. (2 marks)

c) Explain what is Casual consistency? (1 mark)

d) Give explanation on what is happening on the diagram below in terms client and replicas. (1 mark)



e) A component provides services to clients. To provide services, the component may require the services from other components. List four requirements related to dependability? (2 marks)

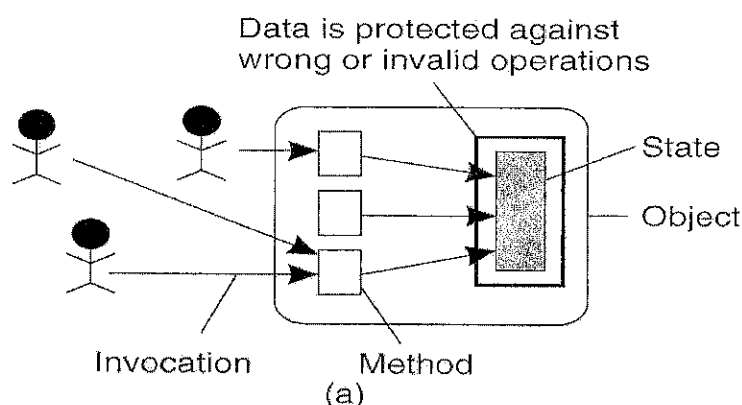
f) When handling faults there are some terminologies that are used. Describe the four terms below. (2 marks)

Term	Description	Example
Fault prevention	1.....	Don't hire sloppy programmers
Fault tolerance	2.	Build each component by two independent programmers
Fault removal	3.	Get rid of sloppy programmers
Fault forecasting	4.	Estimate how a recruiter is doing when it comes to hiring sloppy programmers

Question 8

(10 marks)

- a. Another way of looking at security in computer systems is that we attempt to protect the services and data it offers against **security threats**. There are four types of security threats to consider [Pfleeger, 2003]:
List and explain the four security threats. (2 marks)
- b. Once a security policy has been laid down, it becomes possible to concentrate on the **security mechanisms** by which a policy can be enforced.
Write down four important security mechanisms. (2 marks)
- c. Define the terms Vertical distribution and Horizontal distribution. (2 marks)
- d. Protect against malfunctioning processes through process replication, organizing multiple processes into process group. Describe the two groups - flat groups and hierarchical groups by drawing them in terms of nodes and lines. (2 marks)
- e) When considering the protection of a (possibly distributed) application, there are essentially three different approaches that can be followed, as shown in the diagram below. The first approach is to concentrate directly on the protection of the data that is associated with the application. State the other two approaches. (2 marks)



Section B: Essay

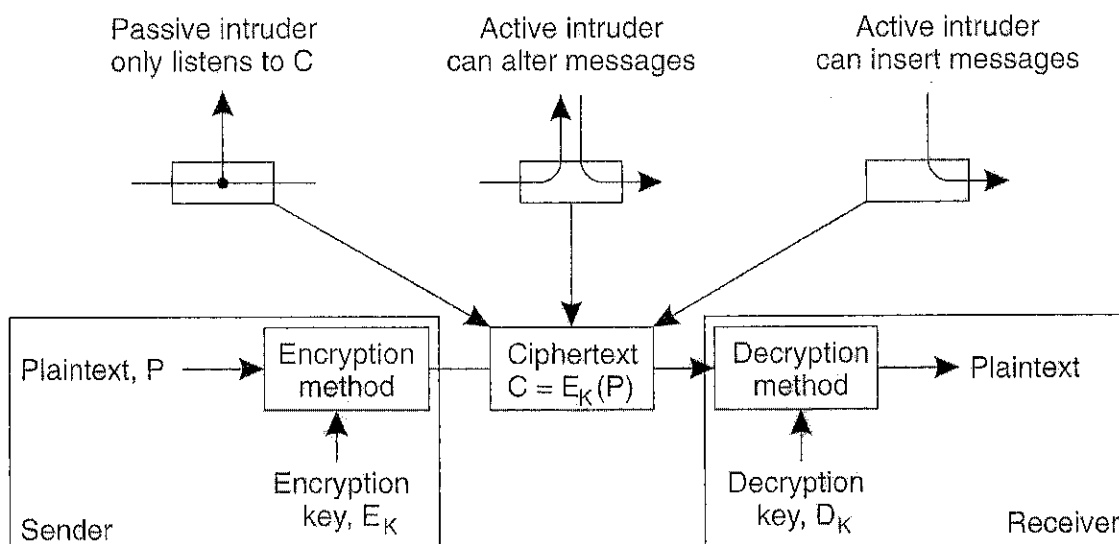
(20 marks)

Answer any **Only two** questions out of the three questions given below.

Question 1

(10 marks)

Encryption and Decryption are accomplished by using cryptographic methods parameterized by keys, as shown in below. Describe what happens in the diagram. Explain what is a plaintext, Ciphertext, encryption, decryption, sender, receiver and intruder.



Question 2

(10 marks)

Remote procedure Call (RPC)

The principle of Remote Procedure Call between a client and server program. When the message arrives at the server, the server's operating system passes it to a *server stub*. It is a piece of code that transforms requests coming in over the network into local procedure calls. Using the client, client stub, client OS, remote OS, server, server stub ..etc. Write down the ten steps involved in calling a remote procedure .

Question 3

(10 marks)

Names are used to refer to entities. Essentially, there are three types of names. An address is the name of an access point associated with an entity, also simply called the address of an entity. An identifier is another type of name. It has three properties: each entity is referred to by exactly one identifier; an identifier refers to only one entity, and is never assigned to another entity. Finally, human-friendly names are targeted to be used by humans and as such are represented as character strings. Given these types, we make a distinction between flat naming, structured naming, and attribute-based naming. Systems for flat naming essentially need to resolve an identifier to the address of its associated entity. This locating of an entity can be done in different ways. Explain the five different approaches.

The End