

Heaven's Light Is Our Guide
RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

4th Year Odd Examination 2019

COURSE NO: CSE 4117 COURSE TITLE: Parallel and Distributed Processing
FULL MARKS: 72 TIME: 3 HRS

- N.B. (i) Answer any SIX questions taking any THREE from each section.
(ii) Figures in the right margin indicate full marks.
(iii) Use separate answer script for each section.

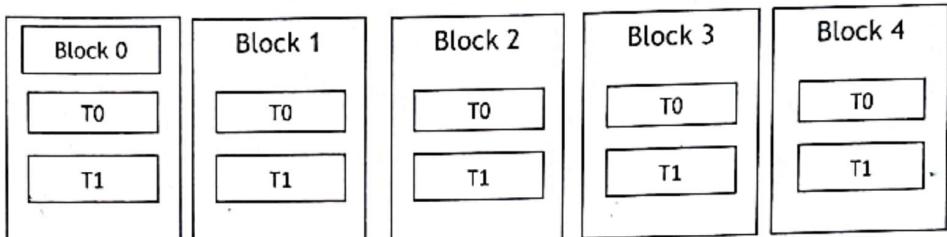
<u>SECTION : A</u>		Marks
Q.1.	(a) Between distributed and parallel processing which one would you prefer in which case? Discuss. (b) Why networking is considered a headache while designing a distributed system? (c) According to your consideration, discuss about most important goal of a distributed system. (d) Which problems would be encountered if a distributed system scales among multiple independent domains?	4 3 3 2
Q.2.	(a) Differentiate between replication and caching? (b) What is hit rate? Does higher cache size guarantee higher hit rate? Discuss. (c) What are most significant differences between DOS and NOS? (d) With suitable example discuss about multi-tiered architecture.	2 3 4 3
Q.3.	(a) Differentiate between logical clock and physical clock. Time of the time daemon is 12:00 rest of the four clocks have time 11:20, 12:45, 10:50 and 12:25. Now show the steps of clock synchronization according to Berkeley algorithm. (b) Consider there are 7(0-6) processes. If both process 2 and 5 finds that the coordinator is not responding, then how will the coordinator be selected according to the ring algorithm? (c) How do deadlock prevention algorithms help to prevent deadlock? (d) Between active replication and primary backup, which one would you choose while dealing with fail silent faults and Byzantine faults? Mention the reasons.	4 3 2 3
Q.4.	(a) Consider the following scenario: There are 3 processes A, B and C with own clocks running at different rates. 1 clock tick in A = 2 clock tick in B = 3 clock tick in C. At time 0 process A sends a message M_1 to process B which reaches process B at time 2. At time 4 process B sends a message M_2 to process C which reaches process C at time 9. At time 12 process C sends a message M_3 to process B which reaches process B at time 12 of process B. Graphically represent the scenario. According to the Lamport's logical clock is there any need to correct the clock of process B? If so then correct it and proceed further assuming process B sends message M_4 to process A. If it is not necessary to correct the clock then proceed further assuming process B sends message M_4 to process A. (b) What is false deadlock? What are the reasons behind false deadlock and how to solve the issue of false deadlock? (c) In a distributed system, to prevent simultaneous access of a shared resource, which algorithm would you chose and why?	7 3 2

SECTION : B

Q.5.	(a) What is NUMA system? Draw a CC-NUMA system. Explain how CC-NUMA have properties of both SMP and cluster with figure (b) Define simultaneous multithreading (SMT). Suppose there are 4 threads W, X, Y and Z running in system. Show how they will be executed using simultaneous multithreading (SMT), interleaved multithreading and blocked multithreading in a super scalar system where it can issue 2 instructions at a time. (c) Define parallel programming model. Describe a parallel programming model with figure where both GPU and CPU can use parallel programming.	4 4 4
Q.6.	(a) What are the essential characteristics of SMP? (b) Define cache coherency in SMP. Explain software and hardware solutions of cache coherency problem in short.	2 4

- (c) Explain three service models of cloud computing with figure and example. 3
- (d) What is array processor? Draw and explain array processor with scalar and array processing capabilities. 3
- Q.7. (a) Why is consumer processor like Intel Core processor multicore not multiprocessor? 3
- (b) What is Graphics processing Unit (GPU)? Why is it also called General Purpose GPU (GPGPU)? 2
- (c) What are the differences between GPU and CPU? Explain with figure. 4
- (d) Write a CUDA C program to run in GPGPU to add 10 numbers which are taken as input from user. Its kernel configuration is shown in figure. 3

CUDA Grid



- Q.8. (a) What is multi-core computer? Design and draw multicores processor organization where 3
- (i) No of cores is 4 where 2 cores are CPU 1 core is GPU & 1 core is DSP.
 - (ii) No of levels of cache memory is 3 where L₁ cache is dedicated and L₂, L₃, cache are shared.
- (b) Explain the importance of cache L₁ and L₂ in Fermi architecture GPU with figure. 3
- (c) What is a mailbox? How a mailbox is used for client server communication? 3
- (d) What are the differences between reincarnation and gentle reincarnation? 3
Why is it tough to track a grand orphan?

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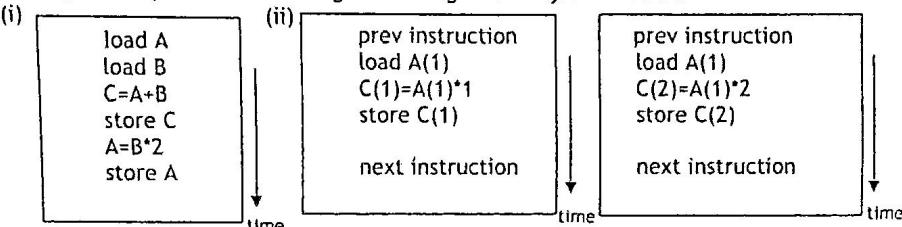
4th Year Odd Semester Examination 2018
COURSE NO: CSE 4117 COURSE TITLE: Parallel and Distributed Processing
FULL MARKS: 72 TIME: 3 HRS

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SECTION : A

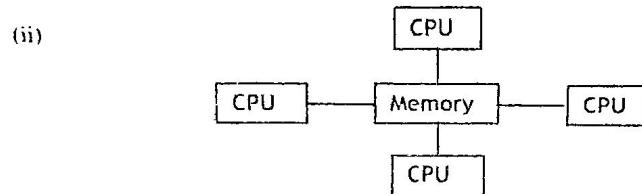
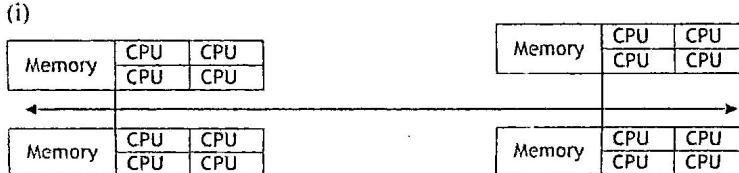
- Q.1.** (a) Define parallel computing. Write the advantages and disadvantages of it in comparison to the traditional computing. 5
(b) Draw a Von Neuman Architecture and hence explain why is it called general for sequential computation? 4
(c) What do you mean by Flynn's classical taxonomy? 3

- Q.2.** (a) Classify and explain the followings according to the Flynn's matrix: 6



- (b) Processor: P Explain Multiple Instruction Multiple Data (MIMD) with necessary example. 4
(c) Processor: P₁ Define (i) Thread (ii) Process (iii) Task (iv) Parallel task 2

- Q.3.** (a) Processor: P₂ With real life example, explain the followings: (i) Coarse Granularity (ii) Fine Granularity and (iii) Speed up. 3
(b) Write the name of memory model for the following figure and hence their advantages and disadvantages. 6



- (c) Suppose you are computing the Fibonacci series such as 1, 1, 2, 3, 5, 8, 13, 21, Is it parallelizable problem? If not so, explain. 3

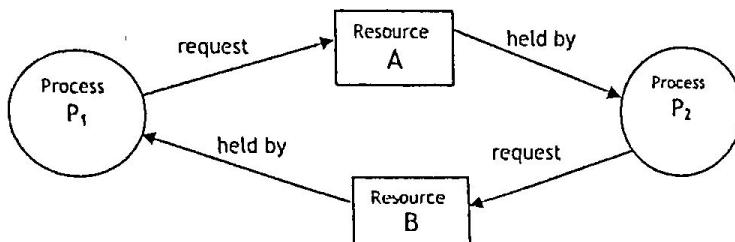
- Q.4.** (a) Define (i) Synchronization (ii) Latency (iii) Bandwidth and (iv) Data dependency 2
(b) Consider the following serial code, how can you explain the parallelism? 3
- ```

do j=1, n
 do i=1, n
 a(i, j)=fcn(i, j)
 end do
end do

```
- (c) Describe briefly (i) why is parallel computing needed? and (ii) challenges for parallel computing. 4  
(d) Explain (i) UMA and (ii) NUMA 3

## SECTION : B

- Q.5.** (a) What do you mean by (i) Multi-core and (ii) Many-core organization? 2  
 (b) What do you mean by (i) tightly coupled (ii) Moderately coupled and (iii) loosely coupled processor architecture? 4 $\frac{1}{2}$   
 (c) Write the scenario from the bellow figure for which deadlock prevention is not possible. 3 $\frac{1}{2}$



- (d) Draw (i) Two-tier and (ii) Three-tier architecture for a distributed scenario. 2

- Q.6.** (a) Explain what is meant by distribution transparency? 2  
 (b) Define the following terms: (i) Access transparency (ii) Failure transparency. 2  
 (c) Determine whether the following statements are true or false. Provide some logic to backup your answers:

(i) It is always a good idea to aim at implementing the highest degree of transparency possible.  
 (ii) A distributed system having computer systems with different operating systems or different data representation schemes, always create great trouble for its users.

- Q.7.** (a) What happens when a parallel program suffers from race condition? 2  
 (b) Determine whether the following statement is true or false. Provide some logic to support your answer:  
 "The race condition in a sequential program is very difficult to find than in a shared memory parallel program."  
 (c) Consider that a parallelized program uses a huge set of variables. What will happen if all the variables in the parallel region are declares as -  
 (i) Private to each thread  
 (ii) Shared between threads running in parallel. 6

- Q.8.** (a) Specify the significance of following constructs in a parallelized program:  
 (i) Critical construct (# pragma omp critical)  
 (ii) Parallel construct (# pragma omp parallel)  
 (iii) Barrier construct ((# pragma omp barrier)) 4  
 (b) Express your opinion regarding the following statement:  
 "Through openMP allows multiple threads to run in parallel, but it compels iterations to be executed in sequential order." 4  
 (c) Specify the main drawback of multiprocessor time-shared bus organization. Is there any way to overcome this limitation? 4

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SECTION : A

- Q.1.** (a) List and describe the design issues used for the distributed system.  $\frac{3}{3}$   
 (b) Define remote procedure call (RPC). Describe the scenario with appropriate neat sketch while transferring an integer and 4-bits string parameter from an Intel 486 machine to the SPARC machine.  $\frac{4}{4}$   
 (c) What does it mean by cache coherence problem? Describe how is it solved by the static coherence check? 4
- Q.2.** (a) What is an open distributed system and what benefit does openness provide? 3  
 (b) What do you mean by geographical scalability and administrative scalability? 4  
 (c) Determine whether the following statement is true or false. Provide some logical evidences to support your answer: "Scaling with respect to size always creates bottleneck problem in a distributed system."  $\frac{2}{3}$
- Q.3.** (a) Define false deadlock. Describe how false deadlock occurs in deadlock detection algorithm in a centralized system. 4  
 (b) Suppose three different machines running three different processes. Their clock rates are different. Use Lamport algorithm to synchronize their logical clock. 4  
 (c) What are the differences between loosely-coupled and tightly-coupled system?  $\frac{3}{3}$
- Q.4.** (a) What do you mean by distributed OS and network OS? What are the differences between them? 4  
 (b) What is distributed algorithm?  $\frac{2}{3}$   
 (c) If all the processes of a distributed algorithm are exactly the same (with no distinguishing characteristics), then which algorithm will be more preferable for selecting the coordinator? 2  
 (d) What happens when two processes of a distributed algorithm detect the demise of the coordinator simultaneously and both decide to hold an election? 4

SECTION : B

- Q.5.** (a) What is cluster? In which perspective a SMP system is better than a cluster?  $\frac{3}{3}$   
 (b) Determine whether the following statements are true or false. Provide some logic to back up your answers:  
     i) The passive standby system is generally not referred as a cluster.  
     ii) SMP systems are far superior to clusters in terms of scalability. 8
- Q.6.** (a) What are the advantages of banyan network over crossbar switch of multi stage network for multi-processor? 4  
 (b) Draw the block diagram of a  $1 \times 8$  demultiplexer that is implemented with  $2 \times 2$  switch boxes.  $\frac{3}{3}$   
 (c) Distinguish between the typical CISC and RISC processor system with appropriate diagram. 4
- Q.7.** (a) What is the impact of pipelining and super pipelining on a single instruction? 3  
 (b) Specify the main drawback of a  $2 \times 2$  crossbar switch. Is there any way to overcome this limitation? 3  
 (c) Create a  $3^2 \times 4^2$  2-stage switching network by using the  $3 \times 4$  crossbar modules.  $\frac{5}{3}$
- Q.8.** (a) Describe the functional structure of a crossbar point in a crossbar network with appropriate neat sketch. 4  
 (b) Explain different techniques to improve the fault tolerance ability of a distributed system.  $\frac{3}{3}$   
 (c) Distinguish between wait-die and wound-wait deadlock prevention techniques. Which method is suitable in transaction processing? 4

N.B.

Full Marks: 70 Time: THREE (03) hours

Answer SIX questions taking THREE from each section.  
 The questions are of equal value.  
 Use separate answer script for each section.

**SECTION A**

- Q1(a)** What do you mean by parallel and distributed processing? Explain them with example. **06**
- (b) Describe the role of middleware in a distributed system. **02%**
- (c) Define (i) task (ii) thread and (iii) Process. **03**
- Q2(a)** What is cache coherence problem? Explain, how is it solved by the static coherence check? **05**
- (b) Distinguish between CISC and RISC processor architecture in brief. **03**
- (c) Briefly describe the RPC mechanism with neat sketch. **03%**
- Q3(a)** What do you mean by false deadlock? Explain how this situation occurs in centralized detection algorithm. **05**
- (b) Does it actually make sense to allow concurrent transactions on a single server? Justify your answer. **03**
- (c) What are the advantages and disadvantages of using parallel computing in comparison to sequential computing? **03%**
- Q4(a)** Define transparency. Why is it necessary in a distributed system? Discuss the factors that must be considered in migration transparency. **05%**
- (b) Explain the system scalability. How can you make a distributed system more scalable? **03**
- (c) Write the importance of encoding and decoding of a message in a distributed system. **03**

**SECTION B**

- Q5(a)** How Berkeley algorithm is used to build active time server in a distributed system? **03%**
- (b) Does the extra message in election algorithm harm the system? **02**
- (c) Classify Group communication. **03**
- (d) Write down the differences between two tiered and three tiered architecture. **03**
- Q6(a)** What strategies can be used to handle deadlocks in distributed system? **03**
- (b) Suppose a distributed system has two machines i) Machine 0 and ii) Machine 1. Machine 0 has process P1 and P2. Machine 1 has process P3 and P4. Now consider the following resource allocation for the process P1, P2, P3 and P4 -
- |       |       |
|-------|-------|
| P1←R1 | P1←R2 |
| P2←R2 | P2←R3 |
| P3←R3 | P3←R1 |
| P4←R4 | P4←R4 |
- Where R1, R2, R3 and R4 are resources.
- i) Now draw the Wait-for-Graph (WFG) of the system.  
 ii) Is there any deadlock in the system? If any then detect the deadlock using Chandy-Misra-Häss algorithm. **06%**
- (c) Are Groups dynamics or static? **02**
- Q7(a)** Write Dijkstra's algorithm to implement mutual exclusion mechanism efficiently. **03**
- (b) What are the differences between lightly coupled and loosely coupled system? **03**
- (c) What are the advantages of buffered crossbar switch over crossbar switch. **03**
- (d) Why Unmapped local memory (ULM) is used in tightly coupled multiprocessor system? **02%**
- Q8(a)** Which parallel processing mechanism you will use in uniprocessor computer? **04%**
- Describe it in details. **03**
- (b) Consider the following expression **03**
- $$z = (x - y) * 3$$
- i) Draw a data flow graph.  
 ii) Show a template implementation of the data flow graph. **04**
- (c) How vector instructions are processed in array processor? **04**

N.B:

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### SECTION A

- | Q.1(a)                                                                                                                                                                                                                                                                                                  | Marks<br>03 <sup>3</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| An alternative definition for a distributed system is that of a collection of independent computers providing the view of being a single system, that is it is completely hidden from users that there even multiple computers. Give an example where this view would come in very hardly.              | 03 <sup>3</sup>          |
| (b) What are the advantages and disadvantages of three-tiered architecture?                                                                                                                                                                                                                             | 05                       |
| (c) Describe the various types of synchronization required for the operating processes when using shared variables.                                                                                                                                                                                     | 03                       |
| Q.2(a) Define transparency. Why is it necessary in a distributed system? Discuss some factors that must be considered in migration transparency.                                                                                                                                                        | 04                       |
| (b) What is an open distributed system?                                                                                                                                                                                                                                                                 | 03 <sup>3</sup>          |
| (c) Explain different techniques to improve the fault tolerance ability of a distributed system.                                                                                                                                                                                                        | 04                       |
| Q.3(a) What is false deadlock? Explain how this situation occurs in centralized detection algorithm.                                                                                                                                                                                                    | 05                       |
| (b) Consider a behavior of two machines in a distributed system. Both have clocks that are supposed to tick 1000 times per millisecond. One of them actually does, but other ticks only 990 times per millisecond. If UTC update come in once a minute, what is the maximum clock skew that will occur? | 03 <sup>3</sup>          |
| (c) Can the model of triple modular redundancy described in the text handle Byzantine failures?                                                                                                                                                                                                         | 03                       |
| Q.4(b) Show that 2 X 2 crossbar switch working method and its buffered internal structure.                                                                                                                                                                                                              | 04                       |
| Construct a 1 by 8 de multiplexer by some 2 X 2 crossbar switch.                                                                                                                                                                                                                                        | 03 <sup>3</sup>          |
| (b) Are the groups dynamic? Distinguish between peer group and hierarchical group.                                                                                                                                                                                                                      | 04                       |
| (c) Should the client-server-side objects for asynchronous method invocation be persistent? Explain.                                                                                                                                                                                                    | 03                       |

### SECTION B

- |                                                                                                                                                                                                                  |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Q.5(a) What is meant by RPC? What are the reasons of increasing the popularity of RPC?                                                                                                                           | 03 <sup>3</sup> |
| (b) Distinguish between typical CISC and typical RISC processor architecture with necessary diagram.                                                                                                             | 05              |
| (c) Discuss the advantages of pipelined processor over no pipelined processor with the help of space time diagram.                                                                                               | 03              |
| Q.6(a) What is meant by q shuffle? How is it applied to a delta network?                                                                                                                                         | 04              |
| (b) Draw a $3 \times 5^2$ delta network.                                                                                                                                                                         | 03 <sup>3</sup> |
| (c) Write an algorithm that implements the mutual exclusive mechanism efficiently by two operations. Which can be shared by many processors and operates on a semaphore?                                         | 04              |
| Q.7(a) What is cache coherence problem? Describe the static coherence check to solve this problem.                                                                                                               | 05              |
| (b) Why ULM is used?                                                                                                                                                                                             | 02 <sup>3</sup> |
| (c) Describe the hierarchical memory structure of parallel processing system with necessary diagram.                                                                                                             | 04              |
| Q.8(a) Is it necessary for a computer to have multiple processor cores or more than one processor to implement parallel processing? Why?                                                                         | 04              |
| (b) In what respect are distributed computing systems better than parallel processing system? Give example of an application for which distributed system will be more suitable than parallel processing system? | 03 <sup>3</sup> |
| (c) Draw the diagram of rotating daisy chain implementation of a system bus.                                                                                                                                     | 04              |

N.B. Answer six questions, taking three from each section.  
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### SECTION-A

Q1. (a) Briefly explain the tasks that belongs to local operating system in a distributed system. 5  
 Why middleware is required in distributed systems?

(b) What is an open distributed system? What benefits does openness provide? 3

(c) Consider a BitTorrent system in which there are S seeds, N clients and each seed and client has a outgoing link bandwidth capacity  $B_{out}$  and incoming link bandwidth of clients are  $B_{in}$ . Seeds voluntarily offers files to be downloaded by others, clients can download files and also help each other to download files from its own. Find out what is the maximum download capacity of a BitTorrent client in this system.

Q3. (a) What is cache coherence problem? Describe briefly the static coherence check to solve this problem. 4

(b) Distinguish between typical CISC and typical RISC processor architecture with necessary diagram. 4

(c) Describe various types of synchronization required for the operating processes when using shared variables. 558 (part 1)

Q3. (a) What are the purposes of Agent Communication Channel (ACC) and Directory service in software agents? Give a real world example of software agents. Mori 4

(b) Suppose you have an internet and no way of communication to other machine outside the network or any other communication devices. Which time synchronization algorithm will you prefer for this system? Why? Mori 4

(c) Can message multicasting or broadcasting be helpful for Berkeley algorithm? Why? (pg-118 S-6) 3

Q4. (a) Write an algorithm that implements the mutual exclusion mechanism efficiently by two operations. Which can be shared by many processes and operates on a semaphore? Chapter 8 (P-539) 4

(b) What is false deadlock? Explain how this situation occurs in centralized detection algorithm. 4

(c) How duplicate message can be handled in message passing system? 3

### SECTION-B

Q5. (a) What is meant by RPC? What are the reasons of increasing the popularity of RPC? RBN 3 2/3

(b) Describe the implementation of RPC mechanism with neat sketch. 4

(c) What are the layers of RMI architecture? What are stub and skeleton and why are they needed in remote procedure calls. 4

Q6. Define reliability of a distributed system. "The existence of multiple instances of the resources in distributed system alone can not increase the system's reliability"- justify your answer. — 3x3 Pg - 300 F 4

(b) Why ordered message delivery is important? Discuss absolute ordering semantics for ordered delivery of multicast message. — 56 - 125 Pg 4 2/3

(c) Does it actually make sense to allow concurrent transactions on a single server? Justify your answer. 3

Q7. (a) Briefly explain how rotating Daisy chaining approach is different from that of static Daisy chaining approach of bus arbitration? 1.11.1 7 5

(b) Draw the block diagram of a 1 by 8 de-multiplexer that is implemented with  $2 \times 2$  switch boxes. 1.8.4 pg - 7 4

(c) What are the benefits of using banyan network over crossbar switch of multistage network for multiprocessors? Chapter - 1 2 2/3

Q8. (a) Define q-shuffle. 7

(b) Using 4 shuffle draw a  $4^2 \times 3^2$  delta network. 7

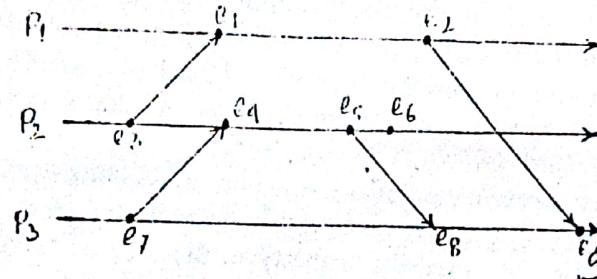
(c) Is it necessary for a computer to have multiple processor core or more than one processor to implement parallel processing? Why? 4

### SECTION-A

- Q1.** (a) Explain the concept of an object reference in a distributed system. Why do remote objects need one and who creates it? 3  $\frac{2}{3}$   
 (b) What are the layers of RMI architecture? What are stub and skeleton and why are they needed in remote procedure calls? 4  $\frac{2}{3}$   
 (c) Does RPC's implemented for processes on the same machine? Define static Vs dynamic remote method invocations? 4

- Q2.** (a) Describe the implementation of RPC mechanism with neat sketch. 04  
 (b) What is the measure of scalability? Discuss briefly three guiding principles for designing scalable distributed system. 04  
 (c) Which method is appropriate for providing fault tolerance between active replication and primary backup and why? 3  $\frac{2}{3}$

- Q3.** (a) Does it actually make sense to allow concurrent transactions on a single server? Justify your answer. 03  
 (b) What are the advantages and disadvantages of a distributed system? 2  $\frac{2}{3}$   
 (c) Consider the events shown for three processes  $P_1, P_2, P_3$  the following figure: 06



- (i) Indicate the happened before relation between the following pirs and events

$e_1 \quad e_3, \quad e_1 \quad e_5, \quad e_1 \quad e_6, \quad e_1 \quad e_8$   
 $e_2 \quad e_4, \quad e_2 \quad e_6, \quad e_7 \quad e_8, \quad e_5 \quad e_6,$   
 $e_6 \quad e_9$

*pairs*

- (ii) Events  $e_7$  has lamport time 1. Indicate the lamport times of all the events.

- Q4.** (a) Define parallel algorithm. What are the differences between synchronized and asynchronous parallel algorithm? C/w p. 5 3  $\frac{2}{3}$   
 (b) Show the  $2 \times 2$  crossbar switch working method and its buffered internal structure. Construct a 1 by 8 demultiplexer by some  $2 \times 2$  crossbar switch. 04  
 (c) Define  $q$  shuffle. How is it applied to a delta network? Explain with an example. 04

### SECTION-B

- Q5.** (a) What is meant by parallel processing? Discuss main features of parallel processing. 3  $\frac{2}{3}$   
 (b) Describe the architectural memory structure of parallel processing system with necessary diagram. 04  
 (c) Distinguish between pipelined VLSI and traditional RISC processor architecture with necessary diagram. 04

*Ch 8.1*  
*clock*

Q6. (a) How might the ~~clocks~~ in two computers that are linked by a local network be synchronized without reference to an external time source? What factors limit the accuracy of the procedure you have described? How could the ~~clocks~~ in a large number of computers connected by the internet be synchronized? Discuss the accuracy of that procedure?

(b) Given an example of a URL. List three main components of a URL, stating how their boundaries are denoted and illustrating each one from your example. To what extent is a URL location transparent?  $\frac{2}{3}$

Q7. (a) A server program written in one language (for example C++) provides the implementation of a BLOB object that is intended to be accessed by clients that may be written in a different language (for example Java). The client and server computers may have different hardware, but all of them are attached to an internet. Describe the problems due to each of the five aspects of heterogeneity that need to be solved to make it possible for a client object to invoke a method on the server object. 06

(b) Suppose that the operations of the BLOB object are separated into two categories- public operations that are available to all users and protected operations that are available only to certain named users. State all of the problems involved in ensuring that only the named users can use a protected operation. Supposing that access to a protected operation provides information that should not be revealed to all users, what further problem arises?  $\frac{2}{3}$

Q8. (a) Describe and illustrate the client-server architecture of one or more major internet applications (for example the web, email or networks) — 50 Pg - Book  $\frac{2}{3}$   
(b) Distinguish between buffering and caching. List the types of local resource that are vulnerable to an attack by an untrusted program that is downloaded from a remote resource and run in a local computer. 04  
(c) Define the integrity property of reliable communication and list all the possible threats to integrity from users and from system components. What measures can be taken to ensure the integrity property in the face of each of these sources of threats. 04

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MAY/2013  
Date 30/06/2013

N.B. Answer six questions, taking three from each section.  
The questions are of equal value.  
Use separate answer script for each section.

### SECTION A

- Q1. (a) Define parallel processing? Distinguish between pipeline computers and array processors. 3 2  
(b) Discuss the advantages of pipelined processor over nonpipelined processor with the help of space-time diagram. 4 3  
(c) Mention the name of parallel processing mechanisms of an uniprocessor computer. Draw the functional structure of an SIMD array processor. 4 4
- Q2. (a) Why does memory conflict occur in tightly coupled multiprocessor? To avoid excessive conflicts, which techniques can be used? 3 3  
(b) What is cache coherence problem? Describe briefly the static coherence check to solve this problem. 4 2  
(c) How do different processes communicate in a multiprocessor environment? 4 3
- Q3. (a) What is meant by a shuffle? How is it applied to a delta network? → Topic 04  
(b) Draw a 3x5 delta network. 04  
(c) Distinguish between the following terms:  
    (i) Master-slave and Floating-Supervisor operating system configurations for multiprocessor computer. → Topic 04  
    (ii) Multiprocessor with crossbar switch and multiprocessor with multiport memory. → T 04

- Q4. (a) What is distributed operating system? What are the major issues in designing a distributed system? 04  
(b) What is meant by transparency? Why is it necessary in distributed system? Discuss the factors that must be considered in case of migration transparency. → Topic 4 2  
(c) Distinguish among multicast, broadcast and unicast communication. → Topic 03

### SECTION B

$$a^{n-1} = \frac{2}{3}^2 = 3 \\ = 3 \\ n-2 \\ 3 \\ 2-2 \\ 3 \\ 2-2 \\ 3$$

- Q5. (a) What is Lamport's "happens before" relation? Discuss the major and minor problem of Cristian's clock synchronization algorithms. 04  
(b) What is meant by RPC? What are the reasons of increasing the popularity of RPC. → Topic 3 2  
(c) What is remote object invocation? Discuss the situation, when an object is passed by reference or by value. 04

- Q6. (a) Distinguish between  
    (i) Uniprocessor and multiprocessor  
    (ii) Serial processing and parallel processing.  
(b) Discuss briefly the Flynn's classification of various computer organization. → Stimulus-2 04  
(c) Prove that a K-stage linear pipeline can be at most k-times faster than that of non-pipelined serial processor. → Topic 3 2

- Q7. (a) What is deadlock? What are the conditions that occur a deadlock? How can it be solved? 05  
(b) What is semaphore? Discuss the synchronization with semaphore. 3 2  
(c) Describe the different types of parallel algorithm. 03

- Q8. (a) What is false deadlock? Discuss Chandy-Misra-Hao distributed deadlock detection algorithm. → Topic 05  
(b) What are the strategies are used to handle deadlock? Why deadlock avoidance is never used in distributed system? 03  
(c) What is three tiered client-server architecture? Describe. → Topic 3 2 → Topic 03

*Heaven's light is our guide*  
**Rajshahi University of Engineering & Technology**  
 B.Sc. Engineering 4<sup>th</sup> Year 8<sup>th</sup> Semester Examination, 2011  
 Department of Computer Science & Engineering  
 Course no: CSE 835 Course Title: Parallel and Distributed Processing

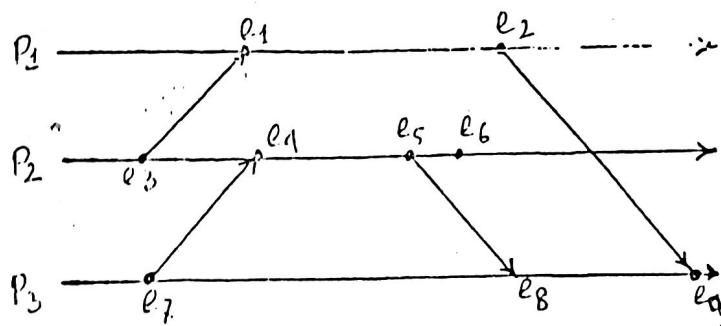
N.B. Answer six questions, taking three from each section.

The questions are of equal value.

Use separate answer script for each section.

### SECTION-A

- Q1** (a) Explain the concept of an object reference in a distributed system. Why do remote objects need one and who creates it. 3  $\frac{2}{3}$
- (b) What are the layers of RMI architecture? What are stub and skeleton and why are they needed in remote procedure calls? 04
- (c) Does RPCs implemented for processes on the same machine? Define static Vs dynamic remote method invocations? 04
- Q2** (a) Describe the implementation of RPC mechanism with neat sketch. 04
- (b) What is the measure of scalability? Discuss briefly three guiding principles for designing scalable distributed system. 04
- (c) Which method is appropriate for providing fault tolerance between active replication and primary backup and why? 3  $\frac{2}{3}$
- Q3** (a) Does it actually make sense to allow concurrent transactions on a single server? Justify your answer. 03
- (b) What are the advantages and disadvantages of a distributed system? 2  $\frac{2}{3}$
- (c) Consider the events shown for three processes  $P_1, P_2, P_3$  the following figure: 06



- (i) Indicate the happened before relation between the following processes and events

$e_1 \quad e_3, \quad e_1 \quad e_5, \quad e_1 \quad e_6, \quad e_1 \quad e_8$   
 $e_2 \quad e_4, \quad e_2 \quad e_6, \quad e_2 \quad e_9, \quad e_5 \quad e_6,$   
 $e_6 \quad e_9$

- (ii) Events  $e_7$  has lamport time 1. Indicate the lamport times of all the events.

- Q4** (a) Define parallel algorithm. What are the differences between synchronized and asynchronous parallel algorithm? 3  $\frac{2}{3}$
- (b) Show the  $2 \times 2$  crossbar switch working method and its buffered internal structure. Construct a 1 by 8 demultiplexer by some  $2 \times 2$  crossbar switch. 04
- (c) Define  $q$  shuffle. How is it applied to a delta network? Explain with an example. 04

Clocks

- Q6. (a) How might the clocks in two computers that are linked by a local network be synchronized without reference to an external time source? What factors limit the accuracy of the procedure you have described? How could the clocks in a large number of computers connected by the internet be synchronized? Discuss the accuracy of that procedure?
- (b) Given an example of a URL. List three main components of a URL, stating how their boundaries are denoted and illustrating each one from your example. To what extent is a URL location transparent?  $\frac{5}{3}$
- Q7. (a) A server program written in one language (for example C++) provides the implementation of a BLOB object that is intended to be accessed by clients that may be written in a different language (for example Java). The client and server computers may have different hardware, but all of them are attached to an internet. Describe the problems due to each of the five aspects of heterogeneity that need to be solved to make it possible for a client object to invoke a method on the server object.
- (b) Suppose that the operations of the BLOB object are separated into two categories- public operations that are available to all users and protected operations that are available only to certain named users. State all of the problems involved in ensuring that only the named users can use a protected operation. Supposing that access to a protected operation provides information that should not be revealed to all users, what further problem arises?  $\frac{5}{3}$
- Q8. (a) Describe and illustrate the client-server architecture of one or more major internet applications (for example the web, email or networks)  $\frac{3}{3}$
- (b) Distinguish between buffering and caching. List the types of local resource that are vulnerable to an attack by an untrusted program that is downloaded from a remote resource and run in a local computer. 04
- (c) Define the integrity property of reliable communication and list all the possible threats to integrity from users and from system components. What measures can be taken to ensure the integrity property in the face of each of these sources of threats. 04

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Course No: CSE 835  
 Full Marks: 70

Course Title: Parallel and Distributed Processing  
 Time: 3 Hours

N.B.

1. Answer any SIX questions, taking THREE from each section.
2. Figures in the margin indicate full marks.
3. Use separate answer script for each section.

### SECTION-A

- Q1(a)** Define parallel processing? Discuss the relationship between parallel processing and distributed processing. 03
- Q1(b)** Discuss the functional structure of SIMD array processor with necessary diagram. 510 (2, 3, 5)
- Q1(c)** Write down some applications of parallel processing in engineering design and automation. 511 (4, 5, 7) 515 (4, 4)
- Q2(a)** Show the 2x2 crossbar switch working method and its buffered internal structure. 58 (4, 4, 3)
- Q2(b)** Construct a 1 by 8 demultiplexer by some 2x2 crossbar switch. 54 (4, 4, 5)
- Q2(c)** What is Banyan network? Form a (2,2,2) Banyan graph. 5b-29  $\rightarrow$  Toma 04
- Q2(d)** What is delta network? Draw a  $4^2 \times 3^2$  delta network. 5b-29, 30  $\rightarrow$  T 03
- Q3(a)** What is remote procedure call? Briefly explain the steps of a remote procedure call. 53 (7, 3, 3)
- Q3(b)** Write down the failures that occur in RPC system.  $\rightarrow$  Toma 03
- Q3(c)** A process with transaction timestamp 50 needs a resource held by a process with transaction timestamp 100. What happens in:  
 i. Wait-die?  
 ii. Wound-wait?
- Q4(a)** Write an algorithm that implements the mutual exclusion mechanism efficiently by two operations. Which can be shared by many processes and operates on a semaphore? 04
- Q4(b)** What is false deadlock? Explain how this situation occurs in centralized deadlock detection algorithm. 54 (5, 9), 5-13, V-16
- Q4(c)** Define a shuffle. How is it applied to a delta network? Explain with an example. 497H 03%  
 $\rightarrow$  Toma

### SECTION-B

- Q5(a)** Classify the digital computers according to the multiplicity of instruction and data streams. What are the differences among them? Briefly explain with necessary diagram. 5-10 (3, 2, 3) 04
- Q5(b)** Discuss the variations of PRAM model regarding the handling of simultaneous access of several processors to the same location of the global memory. 55 (3) 04
- Q5(c)** Describe various types of synchronization required for the operating processes when using shared variables. 03%
- Q6(a)** What is cache coherence problem? Describe briefly the static coherence check to solve this problem. 51 (5) 03%
- Q6(b)** Distinguish between typical CISC and typical RISC processor architecture with necessary diagram.  $\rightarrow$  Toma 04
- Q6(c)** What are the major steps to execute an instruction in a pipeline computer? Explain briefly with space-time diagram. 5-10 (2, 0, 2) 04
- Q7(a)** In what respect are distributed computing systems better than parallel processing system? Give example of an application for which distributed computing system will be more suitable than parallel processing system. 5-10 (7, 8) 03
- Q7(b)** What is meant by transparency? Why is it necessary in distributed system? 51 (5-3 (5)) 03
- Q7(c)** Define reliability of a distributed system. "The existence of multiple instances of the resources in distributed system alone can not increase the system's reliability" - Justify the statement. 03%
- Q7(d)** State different dimensions of scalability measurement. 70 7 5-3 (5) 02
- Q8(a)** "Dealing with Byzantine faults is going to be much more difficult than dealing with fail-silent ones." Justify the statement. -T 03%
- Q8(b)** What is "k fault tolerant"? Can the model of triple modular redundancy handle Byzantine failures?  $\rightarrow$  T 05
- Q8(c)** What logical clock and physical clock? Discuss Lamport's algorithm for assigning times to events.  $\rightarrow$  Toma 03

N.P.

1. Answer the SIX questions, taking THREE from each section.  
 2. Figures in the margin indicate full marks.  
 3. Use separate answer script for each section.

### SECTION-A

- Q1(a) What is the difference between loosely coupled system and tightly coupled system? Q1-1 03
- (b) How temporal parallelism is performed in pipeline computers? Explain with necessary example. Q1-2 04%
- (c) Describe the hierarchical memory structure of parallel processing system with necessary diagram. Q1-3 04
- Q2(b) Describe various types of synchronization required for the operating processes when using shared variables. Q2-1 04
- (c) For which conditions a deadlock situation may occur? How it can be handled? Q2-2 03%
- (d) What are the major steps to execute an instruction in a pipeline computer? Explain in brief with the space-time diagram. Q2-3 04
- Q3(a) Discuss multiprocessor with crossbar switch and multiprocessor with multiport memory. Q3-1 06
- (b) What is cache coherence problem? Describe briefly the static coherence check to solve this problem. Q3-2 04
- (c) What are the requirements that must be satisfied for mutual exclusion? Operating System 01%
- Q4(a) How do different processes communicate in a multiprocessor environment? Explain briefly. Q4-1 03
- (b) Draw a  $2^3 \times 2^3$  delta network. S-1 04
- (c) What are the synchronization/communication features for developing a user-friendly parallel programming environment? Q4-3 02%
- (d) What do you mean by a q shuffle? How it is applied to a delta network? Tomek 02

### SECTION-B

- Q5(a) Why is it not always a good idea to aim at implementing the highest degree of transparency possible? S-6 (P-3) 02
- (b) What are differences between two-tiered and three-tiered client-server architecture? S-5 03
- (c) What are differences between a distributed operating system and network operating system? S-3 (B-3) 03
- (d) When a system is called scalable? How can you make a distributed system more scalable? S-6 (P-3) Suma 03%
- Q6(a) Describe the basic components of cell messages in RPC. 83-69 03
- (b) What are the methods for broadcasting a client's request in a broadcast RPC mechanism? S-2 02
- (c) Explain why most RPC system do not use acknowledgement messages? S-8 (C-2) 03%
- (d) What is a datagram? Why multi-datagram messages are used in IPC? S-6, 8.1 03
- Q7(a) What are the differences between  
 (i). Compile time versus Runtime objects. S-2 - S-7  
 (ii). Persistence and Transient objects. S-3 - S-8  
 (iii). Static versus Dynamic Remote Method Invocation. S-14 - Q10 06
- (b) Discuss Cristian's clock synchronization algorithm and explain the problems of this algorithm. S-5 P-4, 123 - S-15 - 1-16 05%
- Q8(a) Which method is better to handle Byzantine faults between active replication and primary backup? Why? S-1 - Q3 (P-3) 02
- (b) How many policies are used to design load sharing algorithm for a distributed system? Describe one of them in brief. 05
- (c) What do you mean by interprocess communication (IPC)? What are the methods of information sharing in IPC? Explain book / 10.6 - 4 04%

Course No: CSE 835

Total Marks: 70

Course Title: Parallel and Distributed Processing

Time: 3 Hours

N.B.

1. Answer any SIX questions, taking THREE from each section.
2. Figures in the margin indicate full marks.
3. Use separate answer script for each section.

### SECTION-A

- ~~Q1(a)~~ Define parallel processing? How does it differ from distributed system? ~~S1 S-7~~ 03
- (b) Describe briefly the shared memory model in parallel processing. ~~Pg. 59~~ 04%
- (c) Describe the different types of PRAM model regarding the handling of simultaneous access of several processors to the same location of global memory. ~~S-5 (3)~~ ~~Pg. 52-59~~ 04%
- ~~Q2(a)~~ What is tightly coupled multiprocessor? Describe the functional structure of tightly coupled multiprocessors. ~~470 Pg. 51~~ 04%
- ~~(b)~~ What is Banyan network? Describe briefly and form a (2,2,2) Banyan graph. ~~1579 821 P-17~~ 04
- ~~(c)~~ What are the differences between mutual exclusion and condition synchronization? ~~Pg. 558~~ 03
- ~~Q3(a)~~ Define parallel algorithm. What are the differences between synchronized and asynchronous parallel algorithm? ~~S2 P-20~~ 04
- ~~(b)~~ Distinguish between typical CISC and typical RISC processor architecture with necessary diagram. 03
- ~~(c)~~ Discuss some techniques for deadlock prevention and avoidance. ~~580~~ 04%
- ~~Q4(a)~~ What are the differences between Multiprocessor with crossbar switch and multiprocessor with multiport memory? ~~12 S4 (48.1)~~ 04
- ~~(b)~~ Why the I/O subsystem is asymmetric in a multiprocessor system? How the availability is increased in an asymmetric I/O subsystem? ~~S1 P-5, 6~~ 04
- ~~(c)~~ Draw a  $2^8 \times 2^3$  delta network. ~~P-~~ 03%

### SECTION-B

- ~~Q5(a)~~ Write the functional structure of an SIMD array processor. ~~K3 D A (800) L-32~~ 04
- ~~(i)~~ What is cache coherence problem? Describe briefly the static coherence check to solve this problem. ~~51 P-4~~ 04%
- ~~(c)~~ Explain what is meant by transparency. Give examples of different types of transparency. ~~36 Pg. 21~~ 03
- ~~Q6(a)~~ A process with transaction timestamp 50 needs a resource held by a process with transaction timestamp 100. What happens in: ~~11~~ 03
- ~~(i)~~ Wait\_die?  
~~(ii)~~ Wound\_wait? ~~E~~
- ~~(b)~~ Discuss the technique to pass reference parameters in RPC system with example. ~~53-75~~ 04%
- ~~(c)~~ What is the group management for One to Many communication? 04
- ~~Q7(a)~~ Which method is appropriate for providing fault tolerance between active replication and primary backup and why? ~~Q3 (1) 215 S-8~~ 03
- ~~(b)~~ What is meant by Fail-silent faults and Byzantine faults? Can the model of triple modular redundancy handle Byzantine failures? ~~12.12.13 S-8 216~~ 03
- ~~(c)~~ Discuss one technique to control atomicity and one technique to control message ordering in group communication. ~~15 (6) 1.1.1.6 124~~ 05%
- ~~Q8(a)~~ What is meant by logical clock and physical clock? Discuss Lamport's algorithm for assigning times to events. ~~3-13 (v2.0-124)~~ 04%
- ~~(b)~~ Discuss Chandy-Misra-Haas distributed deadlock detection algorithm. ~~DOC-179~~ 04
- ~~(c)~~ How Null Buffer strategy in case of message passing can be implemented? ~~S2 1.2.2.27. 22~~ 03

- a. (i) Answer Six questions, taking Three from each Section.  
 (ii) Figures in the margin indicate full marks.  
 (iii) Use separate answer script for each section

| Q. No.  | SECTION-A                                                                                                                                                                                                                            | Marks |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Q. 1(a) | Define parallel processing. How does it differ from distributed system? <u>K-2 A</u>                                                                                                                                                 | 3     |
| Q. 1(b) | Discuss briefly the variations of PRAM model regarding the handling of simultaneous access of several processors to the same location of global memory. <u>S 5 - 3</u>                                                               | 4     |
| Q. 1(c) | Show the different levels of processing as experienced to the mainstream usage of computers. <u>K-2 A</u>                                                                                                                            | 3     |
| Q. 1(d) | Write down some applications of parallel processing in Engineering Design and Automation. <u>Pj: 44</u>                                                                                                                              | 1 2   |
| Q. 2(a) | What is Loosely coupled Multiprocessors? Describe the functional structure of loosely coupled multiprocessor. <u>G 1 P 1 4 6 0</u>                                                                                                   | 4     |
| Q. 2(b) | How do different processes communicate in a multiprocessor environment? Explain briefly. <u>P S 1 (4)</u>                                                                                                                            |       |
| Q. 2(c) | Define message passing for inter process communication. What programming models are introduced for message passing? <u>G 3 - 2 0, 2 3</u>                                                                                            | 2     |
| Q. 2(d) | Define some special functional models which reside to various functional boards in a multiprocessor system. <u>G 1 P 1 4 6 0</u>                                                                                                     | 2     |
| Q. 3(a) | Show the 2x2 crossbar switch working method and its buffered internal structure. Construct a 1 by 8 demultiplexer by some 2x2 crossbar switch. <u>G 2 / 1 5</u>                                                                      | 4     |
| Q. 3(b) | What are the requirements that must be satisfied for Mutual exclusion? Describe the centralized approach for Mutual exclusion shortly. <u>K-2 C</u>                                                                                  | 5     |
| Q. 3(c) | Write the conditions for a Deadlock. How it can be overcome? <u>S - 4 (5 7 9)</u>                                                                                                                                                    | 2     |
| Q. 4(a) | What is cache coherence problem? Describe briefly the static coherence check to solve this problem. <u>R S 3 2 1 (3)</u>                                                                                                             |       |
| Q. 4(b) | Consider a finite buffer of size n arranged as a circular queue. Explain how does a process consume the sequence of output which are produced and added by another process by a producer consumer relationship. <u>P - S 6 7 Q 3</u> | 3     |
| Q. 4(c) | Distinguish between typical CISC and typical RISC processor architecture with necessary diagram. <u>R</u>                                                                                                                            | 3     |
| Q. 4(d) | Explain the terms: (i) Inclusion and (ii) Locality. <u>G 2 / 2 2</u>                                                                                                                                                                 | 2     |

### SECTION-B

|         |                                                                                                                                                                                |     |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Q. 5(a) | Processor Pool Model                                                                                                                                                           | 4 2 |
|         | How information can be shared among two or more processors? Shortly describe them with figures.                                                                                | 4   |
|         | What is MTU, Single Datagram message and Multidatagram message? Why they are necessary.                                                                                        | 3   |
| Q. 5(b) | What is fault tolerance? Describe briefly the redundancy techniques to improve the fault tolerance ability of a distributed system.                                            | 3   |
| Q. 5(c) | What is meant by transparency? Why is it necessary in distributed system? Discuss the factors that must be considered in case of migration transparency. <u>S - 1 9 (5, 6)</u> | 4   |
| Q. 5(d) | What are the purposes of resource manager? Explain briefly. <u>G 2 / 2 2</u>                                                                                                   | 1 2 |
| Q. 5(e) | What are the primitives that a binding agent uses? Describe the steps that are used to locate a server using binding agent. <u>G 2 / 2 2</u>                                   | 3   |
| Q. 6(a) | What is meant by idempotency? Explain with an example the exactly-once semantics for avoiding duplicate request.                                                               | 3 2 |
| Q. 6(b) | What are the semantics used for synchronization imposed on two communicating processes?                                                                                        | 2   |
| Q. 6(c) | Distinguish among Multicast, Broadcast and Unicast communication. <u>K - 9 / C</u>                                                                                             | 3   |
| Q. 6(d) | What is synchronous mode of communication? Write the advantages and disadvantages of it.                                                                                       | 3   |
| Q. 7(a) | If a client wants to compute factorial 6 using two remote PC what the messages should be used by them for both successful and unsuccessful result?                             | 4   |
| Q. 7(b) | Determine the serial and optimal task assignment cost from the tables                                                                                                          | 5   |

| CPU | $C_{ij}$ | Task Assignment Cost |       |       |       |       |       | $n_1$ | $n_2$    |          |
|-----|----------|----------------------|-------|-------|-------|-------|-------|-------|----------|----------|
|     |          | $t_1$                | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ |       |          |          |
|     |          | 0                    | 6     | 4     | 0     | 0     | 12    | $t_1$ | 5        | 10       |
|     |          | /0                   | 8     | 12    | 3     | 0     |       | $t_2$ | 2        | $\infty$ |
|     |          |                      | 0     | 0     | 11    | 0     |       | $t_3$ | 4        | 4        |
|     |          |                      |       | 0     | 5     | 0     |       | $t_4$ | 6        | 3        |
|     |          |                      |       |       | 0     | 0     |       | $t_5$ | 5        | 2        |
|     |          |                      |       |       |       | 0     |       | $t_6$ | $\infty$ | 4        |

|     |                                                                         |              |     |
|-----|-------------------------------------------------------------------------|--------------|-----|
| (e) | How the buffer overflow problem can be handled in finite buffer system. | <u>S 6 7</u> | 2 2 |
|-----|-------------------------------------------------------------------------|--------------|-----|

~~"Our Guide"~~  
**Rajshahi University of Engineering & Technology**  
 B.Sc. Engineering 4<sup>th</sup> Year 8<sup>th</sup> Semester Examination, 2005  
 Course No: CSE 835 Course Title: Parallel and Distributed Processing  
 Full Marks: 70. Time: Three (03) Hours

- N.B. (i) Answer Six questions, taking Three from each Section.  
 (ii) Figures in the margin indicate full marks.  
 (iii) Use separate answer script for each section.

### SECTION A S-4 CS65

|                                                                                                                                                                                 | Marks                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Q.1                                                                                                                                                                             | 3                    |
| (i) Define the mutual exclusion mechanism efficiently by two operations, which can be shared by many processes and operate on a semaphore.                                      |                      |
| (ii) What is Banyan network? Describe briefly and form a (2,2,2) Banyan graph.                                                                                                  | 3 $\frac{1}{2}$      |
| (iii) Define q shuffle. How is it applied to a delta network? Explain with an example.                                                                                          | 3                    |
| Q.2                                                                                                                                                                             | 2                    |
| (i) What are the differences between distributed system and parallel processing?                                                                                                | Not                  |
| (ii) Classify the digital computers according to the multiplicity of instruction and data streams. What are the differences among them? Briefly explain with necessary diagram. | 4                    |
| (iii) Discuss the variations of PRAM model regarding the handling of simultaneous access of several processors to the same location of the global memory.                       | 4                    |
| (iv) Write the work optimal algorithm for computing prefix sum of n numbers. What is the time complexity of this algorithm and how many processors are required?                | 3 $\frac{1}{2}$      |
| (v) Describe various types of synchronization required for the operating processes when using shared variables.                                                                 | 3                    |
| (vi) Draw a $3 \times 2$ delta network with identity permutation.                                                                                                               |                      |
| (vii) For which conditions a deadlock situation may occur? How it can be handled?                                                                                               | 3 $\frac{1}{2}$ / 79 |
| Q.3                                                                                                                                                                             |                      |
| (i) Describe the hierarchical memory structure of parallel processing system with necessary diagram.                                                                            | 3                    |
| (ii) What is meant by SPARC? Briefly describe the sun Microsystems SPARC architecture.                                                                                          | 4                    |
| Q.4                                                                                                                                                                             |                      |
| (a) Write the mechanism of a functional module of backplane bus specification.                                                                                                  | 3                    |
| (b) What are the synchronization/Communication features for developing a user-friendly parallel programming environment?                                                        | 2 $\frac{1}{2}$      |
| (c) Define the following terms with respect to memory hierarchy:                                                                                                                | 2                    |
| (i) Inclusion (ii) Coherence                                                                                                                                                    |                      |

### SECTION B

|                                                                                                                                              |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Q.5                                                                                                                                          | 4                   |
| (a) Define transparency. Why is it necessary in a distributed system? Discuss the factors that must be considered in migration transparency. | 5 $\frac{1}{2}$ (6) |
| (b) What are the advantages of processor pool model?                                                                                         | 2                   |
| (c) What is the main problem of making a system reliable?                                                                                    | 2                   |
| (d) Why is complete failure transparency not achievable? Explain.                                                                            | 3 $\frac{1}{2}$     |
| Q.6                                                                                                                                          | 4                   |
| (a) When is a system called scalable? How can you make a distributed system more scalable?                                                   | 4                   |
| (b) Explain different techniques to improve the fault tolerance ability of a distributed system.                                             | 4                   |
| (c) How duplicate message can be handled in message passing system.                                                                          | 3 $\frac{1}{2}$     |
| Q.7                                                                                                                                          | 4                   |
| (a) Why are encoding and decoding of a message important in a distributed system? How it can be achieved.                                    | 4                   |
| (b) Describe different synchronization primitives of distributed systems.                                                                    | 3 $\frac{1}{2}$     |
| (c) Why ordered message delivery is important? Discuss absolute ordering semantics for ordered delivery of multicast message.                | 4                   |
| Q.8                                                                                                                                          | 4                   |
| (a) What is meant by RPC? What are the reasons of increasing the popularity of RPC?                                                          | 3 $\frac{1}{2}$     |
| (b) Describe the implementation of RPC mechanism with neat sketch.                                                                           | 4                   |
| (c) How many policies are used to design a load-sharing algorithm for a distributed system? Describe one of them in brief.                   | 4                   |

N.B. Answer six questions, taking three from each section.  
The questions are of equal value.  
Use separate answer script for each section.

### SECTION-A

Q1. (a) What is meant by parallel processing? Discuss main features of parallel processing.  
(b) Explain briefly the different PRAM models used in parallel processing.  
(c) Classify the digital computers according to the multiplicity of instruction and data streams. What are the differences among these classifications? Explain with necessary diagram.

Q2. (a) What is meant by mutual exclusion? What are the requirements must satisfy for implementing mutual exclusion?  
(b) Define message passing for inter process communication. What programming models are introduced for message passing? Discuss in brief.  
(c) What are the major steps to execute an instruction in a pipeline computer? Explain briefly with the space-time diagram.  
(d) What is called optimal algorithm? Write an algorithm to compute the prefix sum of  $n$  input elements. Find out the time complexity and work done of this algorithm.

Q3. (a) When private cache is used in tightly coupled multiprocessor? Describe the functional structure of a tightly coupled multiprocessor system with private cache.  
(b) What do you mean by  $q$  shuffle? How it is applied to a delta network? Explain with an example.  
(c) Assume a crossbar of size  $p \times m$ , that is there are  $p$  no. of processors and  $m$  no. of memory modules. Prove that for a fixed ratio of  $p/m$ , the expected bandwidth increases linearly with  $m$ .

Q4. (a) Write the availability features and data parallelism features of the language features for parallel programming.  
(b) How deadlock situation is handled in a parallel system? Explain deadlock prevention technique.  
(c) Define semaphore. What is its significance?  
(d) Describe different state transitions of active processes in the course of their lifetimes in the system.

### SECTION-B

Q5. (a) Define distributed system. How does it differ from parallel system?  
(b) What are the advantages of workstation server model of a distributed system?

Q5. (c) What happens to a remote process if a user logs onto a workstation that was idle until now and was being used to execute a process of another workstation? Discuss the commonly used approaches to handle this issue.  
(d) Why migration transparency is important? Discuss the factors that must be considered in migration transparency.

Q6. (a) When a distributed system is called fault tolerant? State the commonly used technique to improve the fault tolerance ability of a distributed system.  
(b) What is the measure of scalability? Discuss briefly three guiding principles for designing scalable distributed system.  
(c) Why Byzantine failures are much more difficult? sources and b<sup>n</sup> destinations.