

MASTER OF TELE-COMMUNICATION ENGINEERING EXAMINATION, 2017  
(2<sup>nd</sup> Semester)

**DISTRIBUTED PROCESSING & NETWORKING**

Time : Three Hours

Full Marks : 100

Answer any *five* questions.

1. a) Consider a distributed system consisting of 10,000 CPUs each running at 50 MIPS. Is it possible to replace the system by a single computer with the same performance? Justify your answer quantitatively. 4
  - b) Draw the schematic diagram of a 32 CPU hypercube. What is the worst case delay in hops? 4
  - c) An experimental file server is replicated four times, each with a 0.90 chance of being up at any instant. Determine the availability of the file server and comment on the result. 4
  - d) Let the maximum clock drift in two different clocks be 1 in  $10^6$ . What is the clock skew 24 hours after they have been synchronized? What should be the resynchronization interval, so that the skew does not exceed 20 ms? 4
  - e) A multiprocessor has 4096 50-MIPS CPUs connected to memory by an Omega network. How fast do the switches have to be to allow a request to go to memory and back in one instruction time? Total how many nodes will be there in the interconnection network? 4
2. a) Discuss a graph-theoretic algorithm for processor allocation in a distributed system. 10
  - b) Consider a matrix multiplication problem  $\mathbf{Ax} = \mathbf{b}$  in which  $\mathbf{A}$  is a  $4 \times 4$  matrix and  $\mathbf{x}$  and  $\mathbf{b}$  are both  $4 \times 1$  matrices. Obtain the dependency graph for the problem and map the problem onto a parallel architecture. Estimate the overall speedup also. 10
3. a) Calculate the vector times of the ten events **a – j** shown in Fig. 1. Use the vector times to demonstrate that **(d, h)** are concurrent events, but event **f** is causally ordered before **e**. Mention the main advantage and disadvantage of a vector clock. 10

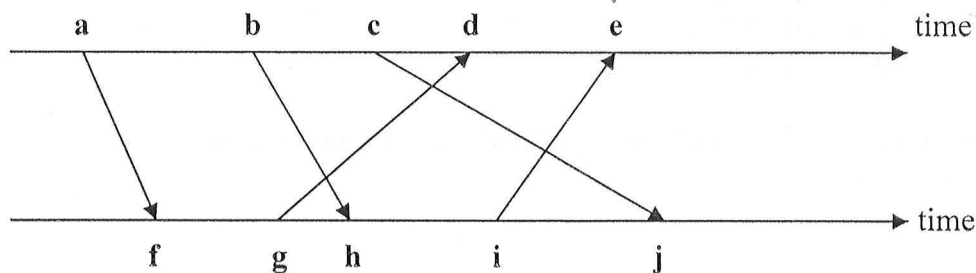


Fig. 1

b) Describe Cristian's algorithm for physical clock synchronization and mention its advantages and disadvantages. 6+4

4. a) What is a real-time system? Write the characteristics of different types of real-time systems. 3+7

b) Discuss the Rate Monotonic Scheduling (RMS) algorithm for real-time systems. Schedule the following processes using RMS algorithm. 10

Process	Execution Time	Period (Deadline)
P1	1	3
P2	1	4
P3	2	6

5. a) Discuss a centralized algorithm for implementation of critical sections in a distributed system. 10

b) Discuss the Bully algorithm for coordinator election in a distributed system. 10

6. a) A conversation in a wireless ad-hoc network is severely disturbed by interference signals according to a Poisson process of rate  $\lambda = 0.1$  per minute. i) What is the probability that no interference signals occur within the first two minutes of the conversation? ii) Given that the first two minutes are free of disturbing effects, what is the probability that in the next minute precisely one interfering signal disturbs the conversation? 5 + 5

b) Given the transition probability matrix P,

$$P = \begin{pmatrix} 0.8 & 0.2 & 0.0 \\ 0.8 & 0.0 & 0.2 \\ 0.0 & 0.8 & 0.2 \end{pmatrix}$$

Draw the Markov chain and compute the steady-state vector. 2+8