INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR   Department: Computer Science and Engineering   Spring Semester: 13
Full Marks: 75   Sub. No: CS60002 Sub. Name: Distributed Systems (Supplementary)


Q1. Answer following questions from balanced sliding window protocol. Let's say values of l_p and l_q are given as 3.

      i)   Current value of s_p is 2. Process P is currently transferring 6th packet to Q. Is the scenario feasible? Justify your answer.

      ii)   Assume that process P current received 5th packet from process Q. Currently it is sending 2nd packet to process Q. Is the scenario feasible?

      iii)   Let's say current value of s_q is 4 and P receives acknowledgement of 4th word from Q. Is the scenario feasible?   2+2+2=6
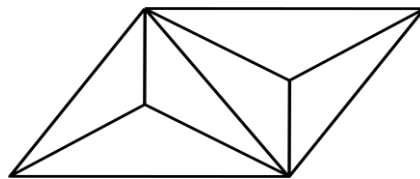
Q2. Define S-path and S-distance. Find $d^S(1,6)$ of following graph when S={4,5}.   2+2=4
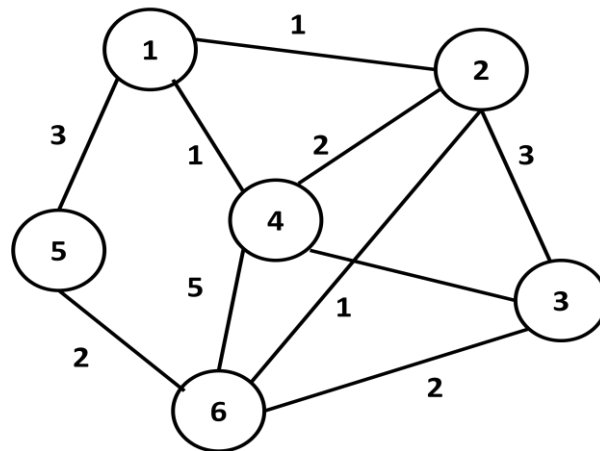
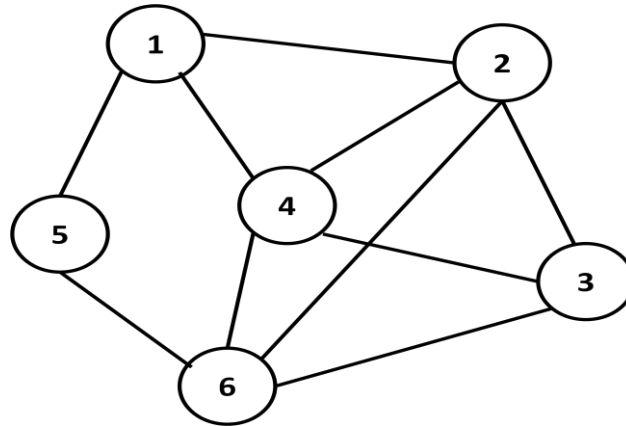Q3. i) Find acyclic oriented cover for the following graph.   2 + 3 = 5

ii) Find number of buffer required to form a deadlock free buffer graph in destination scheme.
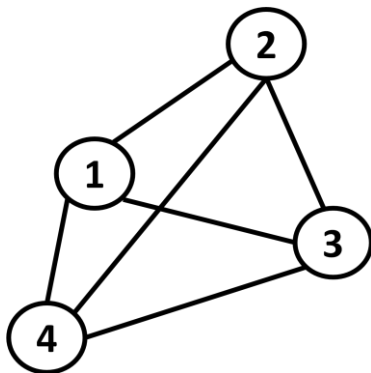
Q4. Dry run Awerbuch's depth first algorithm on following graph, assume graph is visited in sequence of node id number.

Comment on message complexity and run time complexity.

Identify frond edges of graph from dry run.

Why ack message is required?   7 + 2 + 1 + 2 = 12

Q5. Answer following questions from GHS algorithm.

i)   Assume that in GHS spanning tree algorithm unique edge weights are not known a priori. Propose an algorithm to cope up with the situation. Also assume that every node has knowledge about it's outgoing channel. Assumptions should be clearly stated if any. Comment on run time complexity of your algorithm.

ii)   Lets say P and Q are the core nodes of fragment F. Also assume that $bestwt_P > bestwt_Q$. Which node will initiate changeroot message? How the changeroot message propagates? (Answer to the point, within 3-4 sentences)

iii) Lets say $testch_P=Q$. What will be the action of Q in response to test message from P in different scenarios?

iv)   Let's say PQ is the core edge of fragment F. Q receives (report, $bestwt_P$) from P. What action will be taken?   (3 +1) + (1 +2) + 4 + 2 = 13

Q6.   Consider the following CHORD ring and answer the following questions

a) Assume that hash key of a file is mapped to 7. Also assume that a search for the same file is inititated from node 1. During the search of the file a number of nodes and few entries of finger tables of those nodes will be examined. Populate a table in sequence of visit with format given below.

Visit id	Node id	Finger table index	Comments
1			
2			
...	...	...	...

b) Assume a new node is being inserted with hash value 6 and bootstrapping node is node 1. Write down actions taken by existing node and new joinee node. Draw current ring with updated finger tables.

4+6=10
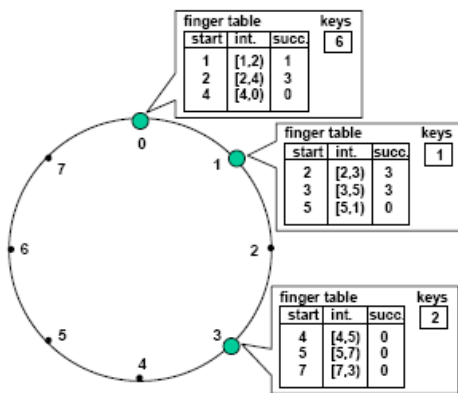
Q7.   Consider the following algorithm for failure detection among n processes. Each process picks k other processes at random and sends heartbeat messages to each of those processes. If a process P_i receives a heartbeat message from process P_j, it will expect further heartbeats to arrive from P_j at regular intervals. If they stop, after some timeout, P_i declares P_j as failed process and broadcasts this to all of the other processes. Suppose m random processes fail at once. What is the probability that not all failures will be detected? You have to clearly state the scenario when detection would not be possible.   5

Q8.

a) Discuss the constraints to design a deadlock free buffer graph controller for Destination based scheme, Hop-So-Far scheme, Acyclic Orientation Cover
b) Discuss the constraints for Forward count and Forward-state controller
c) Prove that there is a deadlock free controller for a tree network which uses only two buffers per node.   6+4+5=15

Q9.   a) Discuss the Dijkstra's self-stabilization algorithm for mutual exclusion for a ring network with an example.

b) Assume that a set of clocks connected as a chain network. This clock starts at 0 and wrap back again after 2. All the clocks run at same phase, however, due to some error they may be out of phase. Describe a self-stabilization algorithm for this system.   5+5=10