Answer THREE questions

1.

a) Describe the basic building blocks in a regular delta network and use them to design a four stage delta-2 network.

[8 marks]

b) Describe the self-routing algorithm used by Banyan networks.

[5 marks]

c) Describe the criteria which must be satisfied for a Banyan network to be non-blocking, and show that they are sufficient. Also describe how the criteria are implemented in practice.

[14 marks]

d) Describe other ways of reducing blocking in Banyan networks.

[6 marks]

2.

A communications experiment gave the following results:

Round-trip time msec	Processor speed MHz	Effective line speed
22	15	57.0
33	12	58.0
26	20	58.4
40	10	58.7
18	25	59.0
35	17	59.2
30	22	60.0
24	27	60.5
20	30	60.7

a) Explain the principle of least square estimation.

[6 marks]

b) Give a detailed explanation of how the least square principles can be used to determine correlation between the variables in the survey.

[13 marks]

c) Determine the relationship between processor speed and round-trip time using the data from the mini-survey.

[14 marks]

3.

a) Outline a procedure used to design store-forward backbone networks and explain the steps involved.

[8 marks]

b) Describe in detail Dantzig's procedure for creating routing tables.

[10 marks]

c) Show how a set of line capacities which will minimise the total cost of the network can be determined subject to a constraint on the mean delay for the network.

[15 marks]

4.

Consider a network with M nodes connected by N links. Each node is assumed to be an independent server with Poisson distributed service rate. The capacity of the i'th link is given as C_i. The total traffic (γ) in the network as well as the way it is routed is assumed to be known.

a) Derive an expression for the mean delay across the network.

[11 marks]

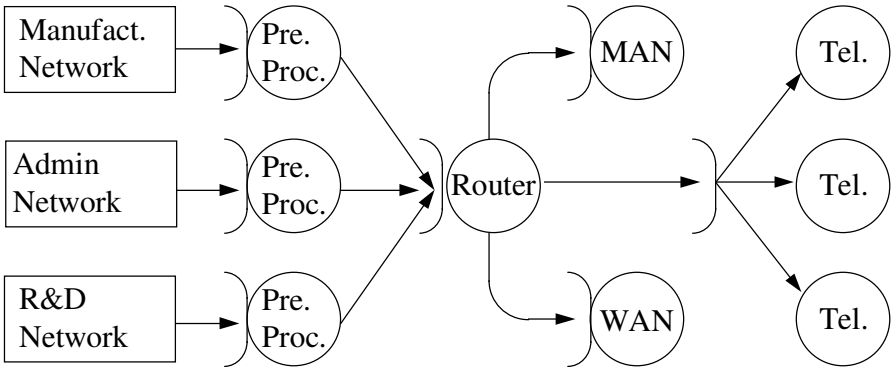
b) Determine the capacities (C_i) which will minimise the total cost of the network provided the mean message delay for the network is constrained.

[15 marks]

c) What would the cost of this network solution be?

[7 marks]

5.



The figure above shows elements of a data gateway used by the Fornda Motor Company. Only the section dealing with outgoing traffic is shown. Data is received from three separate internal networks serving: R&D, Administration and Manufacturing. Traffic from each network is pre-processed by a dedicated server before being queued for the router/switch for distribution to various external networks. All three pre-processors are identical with Poisson distributed service rate with a mean of 400 messages per second. They also have sufficient memory to provide an unlimited number of buffers. The service rate of the router is also Poisson distributed with a mean of 700 messages per second.

Messages from the three networks are Poisson distributed with mean rates of 165 messages per second from R&D, 350 from Administration and 185 from Manufacturing.

a) Determine the mean delay which messages from the Administration network suffer while waiting to be served by the pre-processor.

[10 marks]

b) Determine the mean waiting time and the mean number of messages in the queue if the queue in the router is limited to 36 buffers.

[11 marks]

One of the lines connected to the router is a point-to-point connection to another Fornda site. It consists of three load-sharing leased lines. Each line can be considered a Poisson server with a mean service rate of 15 messages per second.

c) What is the mean number of messages being served if the mean number of messages routed across this connection is 25 messages per second and the system can be considered to have an unlimited supply of buffers?

[12 marks]

END OF PAPER