《 现 代 通 信 技 术 概 论 》 期 末 试 题 试 卷**(A)**

(考 试 形 式 ： 闭 卷   考 试 时 间 ： 2 小 时)

警 示

《中山大学授予学士学位工作细则》第六条

考 试 作 弊 不 授 予 学 士 学 位

方向：＿＿＿＿＿＿＿＿＿＿   姓名：＿＿＿＿＿＿   学号：＿＿＿＿＿＿＿

出卷：＿＿＿＿＿＿＿＿＿＿＿＿＿   审核：＿＿＿＿＿＿＿＿＿＿＿＿

注意：答案一定要写在答卷中，写在本试题卷中不给分。本试卷要和答卷一起交回。

1. **Right or wrong questions.** Please specify the following statements right ("√") or wrong ("×").

   (20 Marks)

   (1) The necessary sampling rate of human voice is 64 kHz.

   (   )

   (2) The "BORSCHT" functions of subscriber's line card indicate the Broadcast, Overload, Relay, Send, Codec, Hybrid, Transmission functions.

   (   )

   (3) The "off-hook" signalling belongs to "inter-exchange" signalling.

   (   )

   (4) In signalling system no. 7, the message transfer part (MTP) is used in establishing calls, clearing calls, passing charging information, and a number of other telephone signalling functions.

   (   )

   (5) The "initial address message" (IAM) is a type of message of signalling system no. 7.

   (   )

   (6) In the fiber attenuation spectrum figure, the absorption peak centered at 1385 nm is caused by the presence of water.

   (   )

   (7) The core of single mode fiber is thinner than the core of multimode fiber.

   (   )

   (8) In mobile communications, the home location register (HLR) contains the database of all mobile subscribers who are visiting this particular serving area.

   (   )

(9) In mobile communications, the purpose of Random Access Channel (RACH) is to indicate to a requesting mobile station which traffic channel or which stand-alone dedicated control channel it is being assigned.

(   )

(10) When a satellite has an elliptical orbit in which the earth is at one focus, it spends less time in that part of the orbit that takes it farthest from earth.

(   )

2. (a) In a 8×8 switching unit, the connection function is
$$f(x_2 x_1 x_0) = x_1 x_2 \overline{x_0}$$
Draw the diagram expression of the switching unit.

(5 Marks)

(b) Draw a three stage 9×9 CLOS network where the input number of each switching unit in the first stage is 3, the numbers of switching units in the second stage are 4, the output number of each switching unit in the third stage is 3.

(10 Marks)

3. Suppose that $X(t)$ is a Poisson process such that E[$X(5)$]=10.
(a) Find the mean and the variance of $X(3)$;
(b) Find $P[X(2) \leq 2]$;
(c) Find $P[X(4) \leq 2 | X(2) \leq 1]$.

Hint: Poisson process $P[X(t) = k] = \dfrac{(\lambda t)^k}{k!} \exp(-\lambda t)$.

(15 Marks)

4. Two communication nodes A and B send files to another node C. Files from A and B require 1 minute and 6 minutes for transmission, respectively. Node C processes one file of node A with 2 minutes and one file of node B with 3 minutes. After the file processing, Node C randomly requests another file from node A with probability of 0.3 or node B with probability of 0.7. What are the throughputs of nodes A, B, and C?

(10 marks)

5. A communication line capable of transmitting at a rate of 5000 bits/second. The packets arrive at a rate of 5 packets/second. The packet lengths are distributed such that 30% of the packets are 250 bits long and the rest are 500 bits long. Determine the average number of packets in queue, average delay per packet and the average number of packets in the system.

Hint: P-K formula $W = \dfrac{\lambda \overline{X^2}}{2(1-\rho)}$.

(15 Marks)

6. Persons arrive at a taxi stand with room for 3 taxis according to a Poisson process with rate 3 persons per minute. A person boards a taxi upon arrival if one is available and otherwise waits in a line. Taxis arrive at the stand according to a Poisson process with rate 4 taxis per minute. An arriving taxi that finds the stand full departs immediately; otherwise, it picks up a customer if at least one is waiting, or else joins the queue of waiting taxis. What is the probability that no taxi is waiting?

(10 marks)

7. Consider the queueing network given below, which consists of 5 single server first-come first-serve nodes.
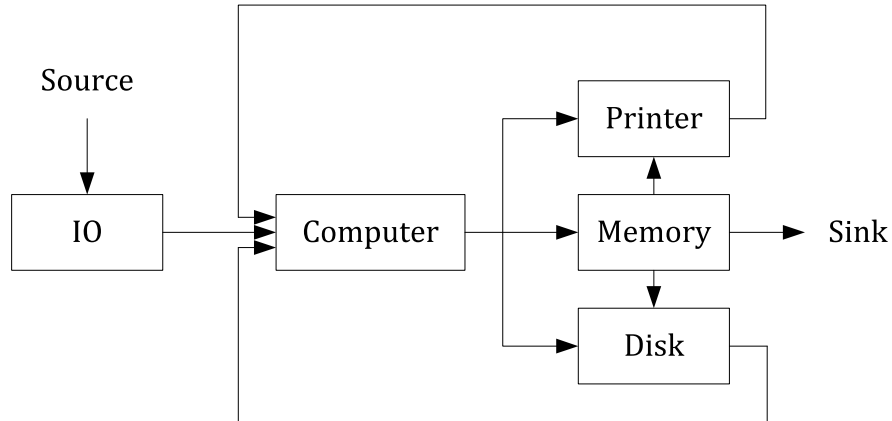
States: Source-0, Computer-1, Printer-2, Disk-3, IO-4, Memory-5, Sink-6

The service times of the jobs at each node are exponentially distributed with respective means:

$$\frac{1}{\mu_1}=0.01 \text{ second}, \quad \frac{1}{\mu_2}=0.025 \text{ second},$$

$$\frac{1}{\mu_3}=0.03 \text{ second}, \quad \frac{1}{\mu_4}=0.1 \text{ second}, \quad \frac{1}{\mu_5}=0.01 \text{ second}.$$

The jobs enter the network from the source with the interarrival time exponentially distributed with the parameter:

$$\lambda = 4 \text{ jobs/second}.$$

Furthermore, the routing probabilities are given as follows:

$$p_{12} = p_{13} = 0.25, \ p_{15} = 0.5, \ p_{21} = p_{31} = p_{41} = 1,$$
$$p_{52} = 0.3, \ p_{56} = 0.2, \ p_{53} = 0.5.$$

(a) Express the number in states 1, 2, 3, 4, and 5 as $(k_1 k_2 k_3 k_4 k_5)$. What is the steady-state probability of state $(k_1 k_2 k_3 k_4 k_5)$ = (3,0,2,1,0)?

(b) What is the total number in the network?

(15 Marks)