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Electronics and Communication Engineering Department

Telecommunication Switching Systems and Networks(ECE 4131)

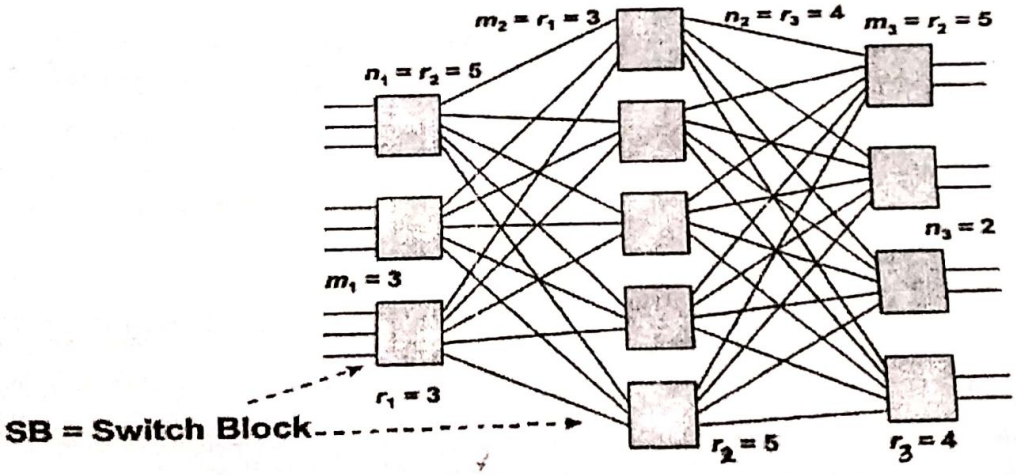
Date:01/05/2019 **End Term- 2019** **Class Size: 96 R**

Time : 3Hrs **Full Marks: 100**

	CO1	CO2	CO3	CO4	CO5
Questions	1a,4a,4b	2c,4c	1b,1c,2a,2b,2d	3,5a,5b,6,7a,8a,8b,8c	5c,7b,7c,7,8d,9
Marks	3+2+2	4+6	3+6+4+3+3	12+3+5+10+2+3+3+2	2+3+2+3+4+10
Marks/Max Marks (%)	7	10	19	40	24

Answers must be brief and to the point. Read questions carefully. All parts of the question must be answered in same place. You can assume value of parameters, if not given, with justification.

Q1. a) Consider the three stage switching system below. Here, m_k is number of inputs in a switch block at stage k, n_k is number of outputs in a switch block at stage k, r_k is number of switch blocks at stage k,



Find

(i) The number of switching elements

(ii) CLOS criteria for strict sense blocking

(iii) Blocking probability

b) Consider the *M/M/1/m* system which is the same as *M/M/1* except that there can be no more than *m* customers in the system and customers arriving when the system is full are lost. Show that the steady state occupancy probabilities are given by

$$p_n = \frac{\rho^n(1-\rho)}{1-\rho^{m+1}}, \qquad 0 \le n \le m$$

c) In a switching system, packets arrive following Poisson distribution. The packets join queue and wait for its turn to service. Packets are served based on a first-come, first-served priority rule. On average, 15 packets per hour arrive at the system. The system server can process on an average of 20

packets per hour, with the service rate being described by an exponential distribution. Calculate the following operating characteristics of the service system.

(i) The average utilization of the server (ii) The average number of packets in the system (ii) The average number of packets waiting in line (iv) The average time a packet spends in the system (v) The average time a packet spends waiting in line (vi) The probability of having more than 4 packets in the system.

[3+3+6=12]

Q2.a) Let us call the two transmission lines 1 and 2, and let $N_1(t)$ and $N_2(t)$ denote the respective numbers of packet arrivals in the interval . Let also $N(t) = N_1(t) + N_2(t)$. Given that $n + m$ arrivals occurred, since each arrival has probability p of being a line 1 arrival and probability $1 - p$ of them will be line 1 and m of them will be line 2 arrivals. Prove that , $\{N_1((t), t \geq 0)\}$ is a Poisson process having rate λp . Similarly $\{N_2((t), t \geq 0)\}$ is a Poisson process having rate $\lambda(1 - p)$

b) The Erlang B formula for C channel and Traffic A is given by

$$E(C, A) = \frac{A^C/C!}{\Sigma_{j=0}^{C} A^j/j!} \text{ where } A = \frac{\lambda}{\mu}$$

Prove that

$$E(C, A) = \frac{AE(C-1, A)}{C + AE(C-1, A)}$$

c) In an STS switch, blocking probability is 0.002 and loading (ρ) is 0.2 Erlang/channel. How many Time Sot Interchange (TSI) modules are required? What is the cost of the switch given $C_{STS} = 2Nk + 4MN$. Also, given, $M_1 = 4$ and there are 128 primary TDM signals and 30 voice channels per input.

$$P_B = \left(1 - \left(1 - \frac{\rho}{k}\right)^2\right)^{M_1}$$

d) Consider an *M/M/1* queuing system with arrival rate 6 customers per second. Find the service rate required, so that the average queue length is 6 customers.

[4+3+4+3=14]

Q3. Consider compressed video transmission in an ATM network. Suppose standard ATM cells (53 Bytes) must be transmitted through 10 switches. The data rate is 54 Mbps.

a) What is the transmission time for one cell through one switch?
b) Each switch may be transmitting a cell from other traffic all of which we assume to have a lower (non-preemptive for the cell) priority. If the switch is busy transmitting a cell, our cell has to wait until the other cell completes transmission. If the switch is free our cell is transmitted immediately. What is the maximum time from when a typical video cell arrives at the first switch (and possibly waits) until it is finished being transmitted by the fifth and last one? Assume that you can ignore propagation time, switching time, and everything else but the transmission time and the time spent waiting for another cell to clear a switch.
c) Now suppose we know that each switch is utilized 70% of the time with the other low-priority traffic. By this we mean that with probability 0.7 when we look at a switch it is busy. Suppose that if there is a cell being transmitted by a switch, the average delay spent waiting for a cell to finish transmission is one-hall a cell transmission time. What is the average time from the input of the first switch to clearing the fifth?
d) What is jitter? Use parts (b) and (c) to calculate the maximum and average variability, respectively, in the delay.

[2+4+3+(1+2) =12]

Q4. a) Show intermediate stage for mapping a DS1 (1.544 Mbps) streams into ATM(149.76 Mbps)

b) Show that the bit rate for STS-3 frame in SONET is 155.52 Mbps.

c) An STS network has 16 incoming and 16 outgoing links, each of which conveys 24 PCM channels. between the incoming and outgoing space switches there are 20 links containing time switches. During busy hour, the network is offered 300 E of traffic and it can be assumed that it is evenly distributed over the outgoing channels. Estimate the GOS , if

i). Connection is required to a particular free channel on a selected outgoing link.

ii). Connection is required to a particular outgoing link, but any free channel on it may be used

[2+2+(3+3)=10]

Q5. a)In an ISDN network when using virtual-circuit transport, the virtual-circuit setup time is 300 ms. Packets travel over a path that goes through 10 links and each link is 144 kbps line. Each packet contains a 7 byte header and 400 bits of data. When using datagram transport, each packet contains a 7 byte header and 400 byte data. However, there is no circuit set up delay. In the following parts ignore the processing delay, propagation delay and queuing delay. How long does it take to transmit N packets using virtual circuit transport and data gram transport?

b)List ATM Service categories with corresponding AAL.

c) Draw the ADSL system architecture.

[3+(3+2)+2=10]

Q6. a) Suppose the population of the world is 7 billion, and that there is an average of 1000 communicating devices per person. How many bits are required to assign a unique host address to each communicating device? Suppose that each device attaches to a single network and that each network on average has 100000 devices. How many bits are required to provide unique network ids to each network?

b) An ATM network uses cells of length 53 octets, consisting of a 48 –octet information field a and a 5-octet header. These are transmitted at 150 Mbps and the propagation delay per km is $5\mu s/km$.

i). Determine the packetization delay for An 8 bit video coder sending at 2Mbps.

ii). A telephone connection is 1000km in length. It passes through 5 switching centres, each introducing a maximum delay of 1 ms (more than his cell will be rejected).Find the maximum delay encountered by the speech signal.

iii). If the number of information bits per cell is trebled to improve the throughput of the network, what effect does this have on telephone transmission?

[(2+2)+(2+2+2)=10]

Q7. a) Draw the frame structure of ATM UNI cell.

b) How this long set up time problem can be solved in MPLS?

c) Why MPLS cannot completely replace ATM?

d) What is the advantage of using label switching in MPLS?

[2+3+2+3=10]

Q8.a) Why signalling is required? Draw the SS7 basic call set up signalling diagram.

b) Identify the A,B,C,D,E,F link in the diagram below.

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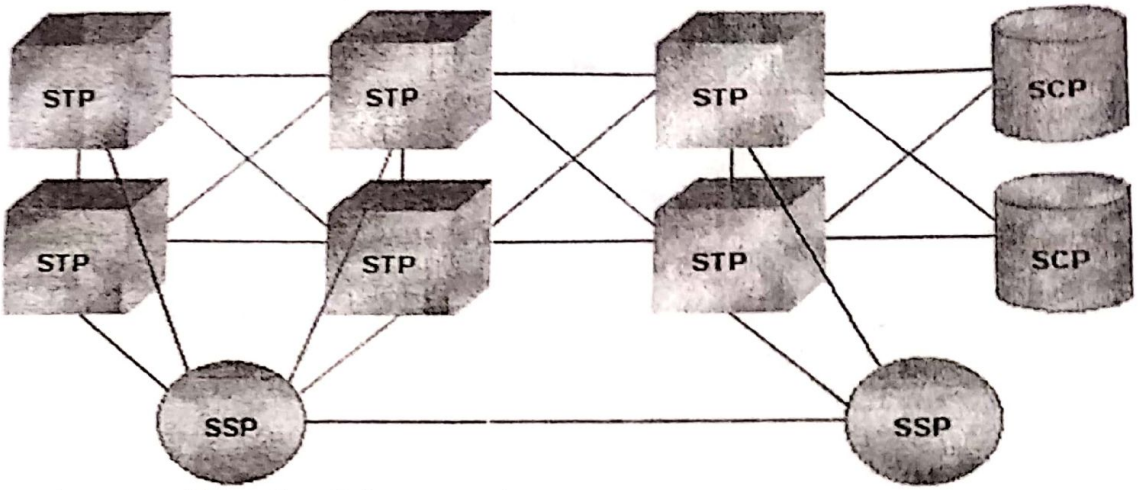

c) What are the types of Signaling Unit structure?
d) Show the condition for which the end-to-end delays for circuit switching and packet switching are equal.

[3+3+2+4=12]

Q9. a) Explain in brief "tear down" phase of a Switched Virtual Connection (SVC) with diagram.
b)The SPE of an STS 3c signal can be a carrier of ATM cells. The SPE of an STS-3c frame has 9 rows and 270 columns. 10 octets are reserved for overhead. How many ATM cells it can carry?
c) Briefly mention the classical IP over ATM solution as provided by IETF.
d)If an application uses AAl3/4 and there are 47787 bytes of data coming into the CS, how many padding bits are necessary? How many dat units gets passed from SAR to ATM layer? How any cells are produced? Please use figure below to answer the question.

[3+2+2+3=10]