Mode of Examination: Online
M Sc. Semester – I Examination, 2020 2020
Subject: Computer Science
Paper Code & Name: CSM 104 Data Communication

Full Marks: 70 Date: 22.03.2021 Time and Duration: 12 pm to 3 pm

Please note the following instructions carefully:

Promise not to commit any academic dishonesty.

Marks will be deducted if the same/similar answers are found in different answer-scripts.

Candidates are required to answer in their own words as far as applicable.

Each page of the answer scripts should have your University Roll # on the right-top corner.

The name of the scanned copy of the answer script will be of the following format: Paper code-Paper Name-My Roll number.pdf

(Example: CSM-104-DC-C91-CSC-201001.pdf)

The subject of the mail should be the file name only.

The scanned answer-script is to be sent to **cucse2020@gmail.com**

The report should have the top page (Page #1) as an index page; mention page number(s) against the answer of each question number.

The answer-script may not be accepted after the scheduled time.

Answer Question No. 1, 2, and any four from the rest.

1. Answer any five questions $5 \times 2 = 10$

   (a) Consider communication between A and B over a channel using GO-BACK N propt-col where the round trip propagation delay is D, data rate is b bps, data frame size is M bits, and acknowledgement frames are very short. what is the minimum number of bits for the sequence number that maximizes utilization?

   (b) If bit stuffing is used for framing with flag 01111110, find out the received message if the transmitted frame is 01111011010011111001011111010.

   (c) Draw the signal waveform for NRZI and Manchester encoding if bits transmitted are 011100110101110

   (d) If a code is of distance 10, what is the maximum number of errors it can correct.

   (e) Give the expression of the signals to encode 00,01,11 and 10 using QAM when the carrier frequency is f,

   (f) Give an example of a binary code consisting of 4 codewords of length 2,3,3 and 4 respectively which is uniquely decipherable but not a prefix code.

2. Answer any 5 questions $5 \times 4 = 20$

   (a) Explain the problem with selective repeat protocol if the sequence number varies from 0 to 6 and the size of buffer in sender and receiver is equal to 3.

   (b) Explain the role of acknowledgement timer when piggybacking is used.

   (c) Critically comment "If the generator polynomial $G(x) = x^2 + x + 1$ in a CRC, then it will detect all even number of errors".

   (d) Consider the hexagonal cell pattern for cellular phone systems. If the co-channel distance is equal to 2, show the channel allocation in a rectangular area with at least 20 Base stations.

   (e) Consider the bit sequence 010010 being repeated over a channel which cuts off all frequencies above 2500Hz. If the bit rate of the channel is 3 Kbps, determine the harmonics with positive amplitude (and their frequencies) which will be present in the received signal.

   (f) We need to use synchronous TDM and combine 30 digital sources, each of 80 Kbps. Each output slot carries 8 bits from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions:

   i. What is the size of an output frame in bits?
   ii. What is the duration of an output frame?
   iii. What data rate the channel carrying the TDM signal must support?

3. Let a node $\boldsymbol{A}$ have to send a message of $\boldsymbol{M}$ bytes to another node $\boldsymbol{B}$ and there are $\boldsymbol{d}$ intermediate nodes. The message is sent by packet switching. Each packet have a payload of $\boldsymbol{p}$ bytes and a header of $\boldsymbol{h}$ bytes. If $\boldsymbol{M\%p = y}$ and $\boldsymbol{M/p = x}$, then first $\boldsymbol{x}$ packets are of size $\boldsymbol{p + h}$. If $\boldsymbol{y > 0}$, then one more packet of size $\boldsymbol{y + h}$ is to be sent. If the data rate is $\boldsymbol{b}$ bps, and there is no queuing delay at nodes, show that time to complete transmission of the message is equal to $\boldsymbol{T = \frac{8}{b}((p + h)d + M + h\lceil\frac{M}{p}\rceil)}$.

   Give an example with suitable values for $\boldsymbol{M}$, $\boldsymbol{d}$ and $\boldsymbol{h}$, such that the optimal packet size is $\left\lceil\sqrt{\frac{Mh}{d}}\right\rceil$. 6+4

4. 4B/5B code in combination with NRZI can help synchronization but not with NRZ. Explain why?

   What is the need for a balanced code?

   How do you define disparity of a code?

   Explain how a 4B/5B code can maintain a disparity of $\pm\mathbf{1}$?

What kind of framing will be suitable for 8B/10B code? 2+1+2+4+1

5. Differentiate the attenuation with distance for optical fiber and wireless communication.

   Give an example of radix-3 code which is a prefix code and have 1 codeword of length 1, 5 codewords of length 2, and 2 codewords of length 3. Show that it satisfies Kraft's inequality. 4+4+2

6. a) Consider two nodes $\boldsymbol{A}$ and $\boldsymbol{B}$ communicating over a channel with data rate 40 Kbps and one way propagation delay of 100 ms. If $\boldsymbol{A}$ sends data frames using GO-BACK-N protocol with a 3-bit sequence number and $\boldsymbol{B}$ only sends back acknowledgement frames of size 40 bits, determine the size of data frames to achieve an utilization of 50%. The channel is being utilized whenever data or acknowledgement frames are transmitted over it.

   b) Suppose that data are transmitted in blocks of sizes $\boldsymbol{M}$ bits. You have to find the maximum error rate $\boldsymbol{r}$ (for every $\boldsymbol{K}$ bits transmitted $\boldsymbol{Kr}$ bits are in error on average) under which error detection and retransmission mechanism ($\boldsymbol{f(m)}$ parity bit per block) is better than using an error correcting code requiring $\boldsymbol{g(M)}$ parity bits. Assume $\boldsymbol{g(M) > f(M)}$, bit errors are independent of one another, and no bit error occurs during retransmission. Show that $\boldsymbol{r < \frac{g(m)-f(m)}{M(M+f(m))}}$

   5+5

7. Write the code for protocol GO-BACK-N when there is a separate acknowledgement timer. Also, explain the necessity of using acknowledgement timer. 7+3

8. What protocols in the data link layer are used to support ADSL? Describe those protocols in your own words. 2+8