Sri Lanka Institute of Information Technology

B.Sc. Special Honors Degree in

Information Technology

Final Examination

Year 1, Semester I – (CSN/IT)

2016 - April

EC143 - Data Communications & Computer Networks I

Duration: 3 Hours

Instructions to Candidates:

- ◆ This paper contains Five (05) questions printed on Seven (07) pages.
- ◆ **Answer all the questions** in the given answer booklet.
- ◆ Total marks **100**.
- ◆ You are **permitted** to use calculators.

12/03/2016

Question 01 (20 marks)

---

1. How long would it take an image which is 1024 pixels by 768 pixels with 16 bit per pixel color encoding to transfer via a 9.6 kbps communication link? (2 marks)

2. Explain how data is transmitted along a fiber optic cable with aid of a diagram. (2 marks)

3. Dispersion is a considerable problem in fiber transmission media.

   a. List down the 3 different types of dispersion in fiber transmission. (2 marks)

   b. Explain the relationship between dispersion and inter symbol distortion. (2 marks)

4. Identify **three** physical characteristics of fiber optic cables that make them more suitable for high speed digital data transmission than copper cables. (3 marks)

5. A composite periodic signal is decomposed in to five sine waves with frequencies of 150, 300, 600, 1200 and 2400 Hz.

   a. What is the frequency bandwidth? (1 mark)

   b. Draw the spectrum assuming highest and lowest frequency components with maximum amplitude of 10V and others 15V? (1 mark)

6. A computer's memory chip takes 166.6 ps to read/write data per cycle. What is the clock frequency of the memory? (2 marks)

7. We can calculate the highest theoretical bit rate for a telephone line. A telephone line normally has a bandwidth of 3000 Hz (300 to 3300Hz) assignment for data communication. The signal to noise ratio is usually 3160.

   a. What is the channel capacity? (2 marks)

   b. The signal to noise ratio is often given in decibels. Assuming that $SNR_{dB} = 36$ and the channel bandwidth is 2 MHz, calculate the theoretical channel capacity. (3 marks)

12/03/2016

Question 02   **(20 marks)**

---

1. Calculate the Nyquist sampling rate for a band-pass signal with a bandwidth of 400 MHz, if the lowest frequency is 100 KHz?   (1 mark)

2. We want to digitize the human voice. The human voice normally contains frequencies from 0 to 4000 Hz. What is the bit rate assuming eight bits per sample?   (2 marks)

3. What is the relationship between a signal's spectrum and its bandwidth?   (2 marks)

---

4. Four channels are multiplexed using TDM. If each channel sends 800 bits/s and we multiplex one bit per channel (bit interleaving).

    a. Show the frame travelling on the link.   (1 mark)

    b. What is the size of the frame?   (1 mark)

    c. What is the duration of a frame?   (2 marks)

    d. What is the frame rate?   (2 marks)

    e. If one bit is added to each frame for synchronization, find the efficiency of the output link?   (2 marks)

5. Sketch the constellation diagram for a 4 level **QPSK** (Quadrature Phase-Shift Keying) modulation scheme. Label each bit with a bit pattern such that there is only a one bit change between adjacent points. Provide **one** reason for why would such a method of coding be used.   (3 marks)

6. An optical storage disk can store 10 PB of data; the disk is 1 mm in thickness. For every moment for the last 5 years in a particular event, a High Definition (HD) video (1,280×720 pixels) with the color information encoded as 24 bits per pixel and a frame rate of 24 frames per second has been recorded. How high is the stack of optical storage disks used to store the video of that period to date?   (4 marks)

2

Question 03 (20 marks)

___

1. What is meant by the term **peer to peer** protocol? (2 marks)

2. Give **one** example of a device on a network that is required to operate in all seven layers of the ISO/OSI Reference Model. (2 marks)

3. The ISO/OSI 7 layer Reference Model partitions a communication system into abstraction layers, each of which is responsible for a specific range of functions. By considering this model, explain the main function performed by a protocol operating at:

   a. The Network layer (3 marks)
   b. The Data Link layer (3 marks)

4. Answer the following questions in relation to IEEE 802 LAN (Local area Network) standards.

   a. Draw IEEE 802.3 and IEEE 802.11 models with reference to the ISO/OSI 7 layered architecture. (2 marks)
   b. Explain why CSMA/CD cannot be implemented in wireless networks? (3 marks)

5. Suppose that a 10 Mbps wireless station is transmitting 50 byte frames one immediately after the other.

   a. How many frames are transmitting within one second? (2 marks)
   b. If the probability of a frame being damaged (having at least one wrong bit) is 0.004, approximately how many frames will be damaged within one hour? (3 marks)

12/03/2016

Question 04 (15 marks)

1. Discuss an advantage and a disadvantage in IP-VPN. (3 marks)

2. The PSTN is designed to establish connection among telephones. The main disadvantage of this method is that the telephone and the computer cannot be used simultaneously. As a solution, nowadays the twisted pair telephone line is additionally able to support Internet access using ADSL technology. Considering the bandwidth utilization method used by ADSL briefly explain how it is able to transmit data over the same line as analogue voice, with the aid of a diagram. (3 marks)

3. There are two customers (customer A and B) connected to the same local telephone exchange and both receive their Internet connection via ADSL. The two customers measured their internet connection download data rate using http://www.speedtest.net/ and it turns out to be 7 Mbps for customer A and the 2 Mbps for customer B. Provide **three** reasons to explain why their actual data rates are so different from each other. (3 marks)

4. Draw Automatic Repeat Request (ARQ) timing diagrams for the following scenario: Transmitter send five (5) frames and the 3rd frame has an error. (3 marks)

   a. use **idle** ARQ
   b. use **selective** ARQ
   c. use **Go-Back-N** ARQ

5. Explain the following **three** transmission modes using diagrams. (3 marks)

   a. Simplex
   b. Half-duplex
   c. Full-duplex

4

Question 05 (25 marks)

1. With the aid of a diagram illustrate how the layers of the TCP/IP protocol suite do correlate to the layers of the OSI model and specify one protocol used for each layer in the internet model. (3 marks)

2. State **one** reason as to why TCP is considered reliable while UDP considered as an unreliable protocol. (1 mark)

3. For each of the following three applications, determine whether you would use TCP or UDP as a protocol. (3 marks)

   a. File transfer
   b. Video streaming
   c. An audio conference

4. *Figure 1* shows a part of a network in which two personal computers A and B, are each connected to a LAN switch 1 **and** LAN switch 2 respectively which are themselves interconnected by a layer 3 router. Consider the transmission of data from personal computer A to B and produce a **protocol layer diagram** that clearly shows how data passes through all of the layers of the ISO/OSI 7 layer reference model that are used within the PCs, switches and router. (9 marks)
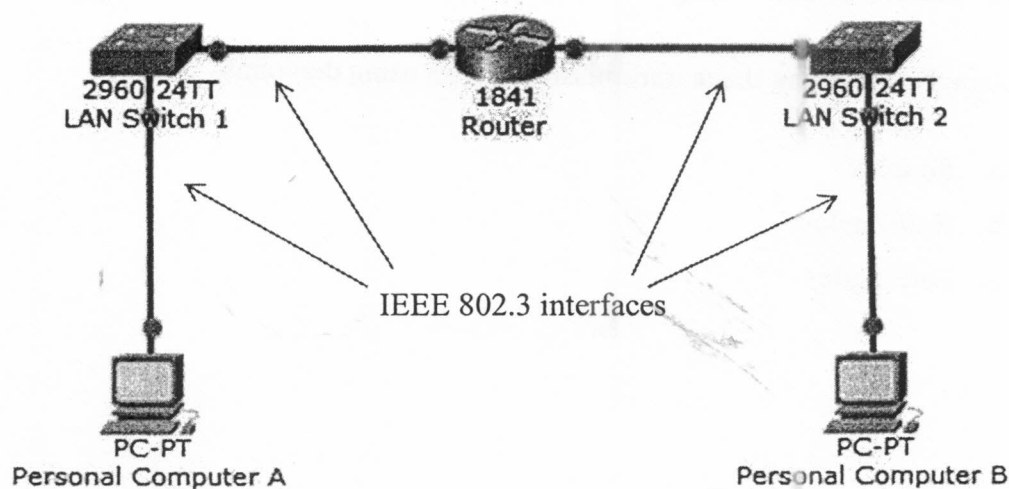

Figure 1

12/03/2016

5. You are been asked to design a network for a company located in a **two** storied building. Following are the requirements for the network.

   o   15 computers in the ground floor and 23 computers in the first floor.

   o   Requires internet connectivity for both first and the ground floors.

   o   Ground floor printer should be able to share with first floor computers.

   o   Facility to use internet for portable computers in the office in both the floors.

   a.   Sketch a network topology diagram and label all devices.   (3 marks)

   b.   Indicate all types of network connection.   (3 marks)

   c.   Explain how you would provide internet facility to the entire building. (3 marks)

~ **End of the Question Paper** ~

12/03/2016