**CpE/NIS 654 – Fall 2017**
**Homework 01**

This homework is primarily to help you refresh your knowledge of how Internet works; or to read up on how it works – quickly. We have posted several good texts, use any of them or the posted slides to gain a basic understanding of the Internet. We also encourage you to use the associated Forums to discuss this subject and to learn from each other. But any submissions should be yours.

All questions carry equal weight.

**Problem 01:** In Weeks 01 - 03 lecture slides, we discuss the evolution of the network starting from the Graham Bell's voice network to the present multimedia networks. Please critique this evolution, in that, how technologies, client's needs, standards, politics, personalities etc. may have shaped this evolution and how under different circumstances it may have evolved to a different network than that of what it looks like today.

**Hint:** To give a good answer, you would need to carefully study how the Internet evolved, think how and why it evolved as it did and what factors may have truly influenced it the way it evolved.

**Problem 02:** Briefly describe your understanding of how VOIP service is provided over Internet. Again the purpose is to encourage you to refresh your knowledge of how telephone worked before Internet and now as Voice Over IP.

**Problem 03:** Suppose your network carries VOIP traffic and you need to size the associated traffic volume. Assume that this VOIP service is using G7.11 codecs (i.e., speech is sampled at 8 KHz and digitized as 8 bits per sample.) Further assume that the voice data is carried in chunks of 20ms in a RTP/UDP/IP packet over Ethernet. What is the data rate of this voice traffic?

**Hint**: You would need to compute the data carried in each packet and all the associated headers to do it right. Don't forget the Ethernet and preamble bits.

**Problem 04**: Briefly describe the concepts behind (a) TDM (Time Division Multiplexing), (b) FDM (Frequency Division Multiplexing), and (c) CDM Code Division multiplexing). What do these techniques achieve and how?

**Problem 05**: There are a number of protocols which enable the routing of the Internet traffic. Briefly describe the roles of:

i. DNS (Domain Name Server),
ii. ARP (Address Resolution Protocol),
iii. DHCP (Dynamic Host Configuration Protocol), and
iv. ICMP (Internet Control Message Protocol)

**Problem 06:** Please choose any one of the above protocols and describe how the Internet would, or would not work, without that protocol.

**Problem 07:** What are MAC and IP Addresses and how do they help in routing a packet?

**Problem 08**: Please research and briefly describe:

a. What is a symbol?
b. The difference between "baud rate" and "bit rate"?

**Hint:** In technology slides, we discuss various coding schemes such as NRZ, Manchester, among others. The clue resides in these coding schemes.

**Problem 09**: Assume that two nodes in a 10Mbps Ethernet cable are 1200 meters apart. Also assume that the signal propagation speed is $2 \times 10^8$ meters/second. What is the minimum required frame length for this Ethernet?

**Hint:** The minimum packet length is dictated by the fact that the collision must be detected by the sending entity before it has completed the transmission all the bits in the Ethernet packet.

**Problem 10**: How many bits can fit in a link with a 2 ms end to end delay if the bandwidth of the link is:

1. 1 Mbps
2. 100 Mbps

**Hint**: Recall or lookup bandwidth-delay product.