Question 1

i. Calculate the percentage of the transmitted bits in the physical layer.

Total Overhead = TCP Layer + IP Layer + IP Packet
= 20 Bytes + 20 Bytes + 18 Bytes
= 58 Bytes

a) X = 90 bytes

Total Packet = Total Overhead + Payload(X)
= 58 Bytes + 90 Bytes
= 148 Bytes

Overhead = (Total Overhead / Total Packet) * 100
= (58 Bytes / 148 Bytes) * 100
= 39.19%

Physical Layer = (Payload(X) / Total Packet) * 100
= (90 Bytes / 148 Bytes) * 100
= 60.81%

b) X = 550 bytes

Total Packet = Total Overhead + Payload(X)
= 58 Bytes + 550 Bytes
= 608 Bytes

Overhead = (Total Overhead / Total Packet) * 100
= (58 Bytes / 608 Bytes) * 100
= 9.54%

Physical Layer = (Payload(X) / Total Packet) * 100
= (550 Bytes / 608 Bytes) * 100
= 90.46%

c) X = 1250 bytes

Total Packet = Total Overhead + Payload(X)
= 58 Bytes + 1250 Bytes
= 1308 Bytes

Overhead = (Total Overhead / Total Packet) * 100
= (58 Bytes / 1308 Bytes) * 100
= 4.43%

Physical Layer = (Payload(X) / Total Packet) * 100
= (1250 Bytes / 1308 Bytes) * 100
= 95.53%

d) I would choose 1250 bytes because, this size allows for more data to be transferred in each frame, and only uses 4.43% of that frame for overhead where as a smaller frame such as 90 bytes is almost 40% in just overhead before you start sending data.

ii. Calculate and answer the following questions:

a. Totally, how many IP packets will be required to send all 1.7 Megabyte of data.

Total Packets = Data / (Max Packet Size – Overhead)
$= (1.7 \times 10^6) / (1500 - 20^2)$
= 4250 Packets

b. How many percent of overhead bytes (out of the original 1.7 megabytes of data) at the IP layer will be required to send all 1.7 Megabyte of data.

Percentage = (Overhead / Total Packets) * 10^2
$= (20^2 / 1500) * 10^2$
= 2.66%

Question 2.

i.

a. IPv4 Addresses Available:
$= 2^{32}$
$= 4.29 \text{ X } 10^9$
= 4.29 Billion

b.

- Estimated Population by 2025
$= (1421 + 670 + 352 + 4689 + 336 + 542) \times 10^6$
=8.01 Billion

- Addresses to each person
= Number of Addresses / Population
$= 4.39 \times 10^9 / 8.01 \times 10^9$
= 0.53 Addresses per Person

c. Using the current population projection, it is not possible to assign 80 addresses to each person, as currently only 0.53 addresses can be assigned.

d. IPv6

- Total IPv6 Addresses
$= 2^{128}$
$= 3.4 \text{ X } 10^{38}$

- Number of Address to Each Person
= Number of Addresses / Population
$= 3.4 \times 10^{38} / 8.01 \times 10^9$
$= 4.24 \times 10^{28}$

- Using IPv6 each person can have $4.24 \text{x} 10^{28}$ addresses allocated to them, therefore assigning 80 addresses to each person is definitely possible

ii.

Subnet Increase = Subnet x % of Increase $^{\text{duration(years)}}$

$= 950 \text{x} 1.05^3$

= 1099.74

iii.

a. 192.168.21.165/27

11111111.11111111.11111111.111 00000

b. 192.168.21.165
c. 192.168.21.191
d. 192.168.21.160
e. 192.168.21.190

Question 3.

i. Bitrate Calculations

a. Video Resolution of 1280x720@60fps 16bit

Rate = Megabits Per Pixel x (W x H) x FPS
= 0.000016 x (1280 x 720) x 60
= 884.74Mbits/sec

b. 4k Resolution 3840 x 2160 @50fps 3bytes

Rate = Megabits Per Pixel x (W x H) x FPS
= 0.000024 x (3840 x 2160) x 50
= 9953.28Mbit/sec

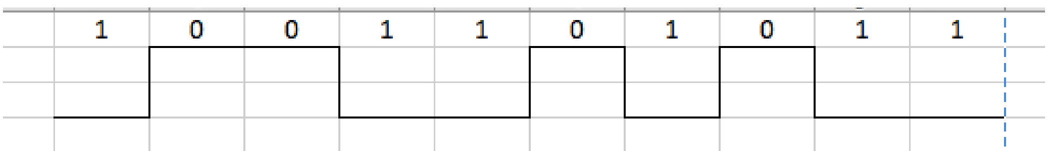
c. Calculate a 30min video clip at quality stated in b over a 10mbps connection

Download Time = (Duration in seconds x Rate) / Download Speed
= ((30 x 60) x 9953.28) / 10
= (1800 x 9953.28) / 10
= 1791590.40 Seconds
= 29858.84 Minutes
= 497.66 Hours
= 20.74 Days

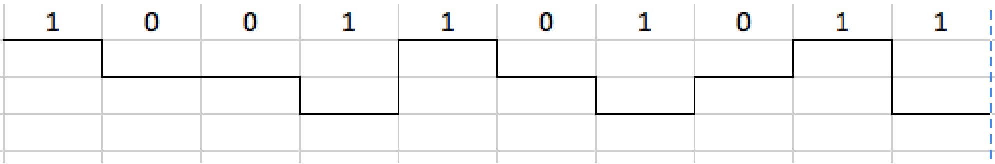
ii. Time Division Multiplexing

iii. Encode Data Stream 1001101011 Using

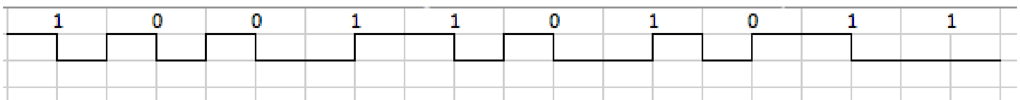
a. NRZ-L



b. Bipolar-AMI



c. Differential Manchester



Question 4.

i. Given a Bit Stream of 11101101 and Pattern 101101001

a. Obtain CRC check bits using base 2 and shifted poly method

b. Obtain CRC on the receiver side (Both Base 2 and Shifted Poly)