Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year

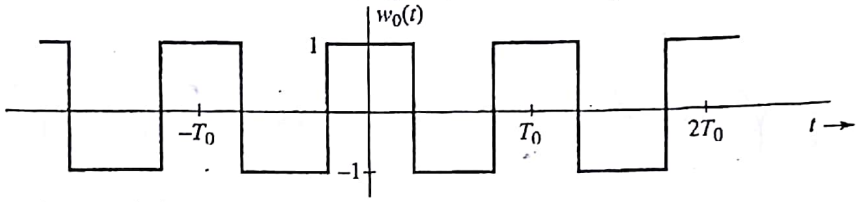
Data transmission
Mid-term Exam
Time: 1.5 hrs

Assume any missing data

Question No.(1) (10 marks)

a. Define the following terms:
Channel capacity, impulse noise, modulation rate, scrambling, inter-symbol interference

b. For the signal $w_0(t)$ shown in the following figure, if the time period $T_0 = 2$ ms,



i. Draw the spectrum of the signal.
ii. Write the expression of the first five components in time domain.
iii. If this signal is applied to a filter of 700 Hz, draw the output of the filter.

Question No.(2) (10 marks)

a. Answer the following questions about the transmission media used for data transmission
i. What are the advantages and disadvantages of the optical fiber?
ii. What is the reason for which the wires of the twisted pair cable are twisted?
iii. Discuss the differences between the terrestrial microwave and satellite microwave.

b. A microwave transmitter has an output of 0.1 W at 2 GHz. This transmitter is used in a microwave communication system where the transmitting and receiving antennas are parabolas, each 1.2 m in diameter. Assuming that the transmitting antenna is located at a height of 75 m and the receiving antenna is located 24 km from the transmitting antenna over a free space path
i. What is the gain of each antenna in decibels?
ii. What is the effective radiated power of the transmitted signal?
iii. Calculate the available signal power out of the receiving antenna in dBm units.
iv. If the adjustment factor is taken as 4/3, what should be the height of the receiving antenna to achieve LOS?
v. Find the free space loss in dB/Km over the link between the two antennas.

Question No.(3) (10 marks)

a. List and briefly define important factors that can be used in evaluating or comparing the various digital-to-digital encoding techniques.

b. A digital signaling system is required to operate at 9600 bps,
i. If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?
ii. If the signal is transmitted using FSK at carrier frequency of 250 KHz, what will be the difference frequency that can achieve the minimum bandwidth calculated in (i)?
iii. Calculate the frequency of each signal element of the FSK signal.

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year

Data transmission
Mid-term Exam
Time: 1.5 hrs

Assume any missing data

Question No.(1) (10 marks)

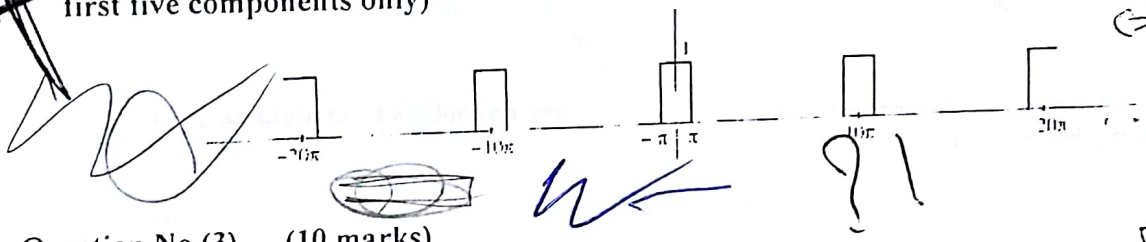
a. Define the following terms:
Channel capacity, intermodulation noise, omnidirectional antenna, critical angle of reflection, multipath interference.

b. Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white thermal noise,
i. What signal-to-noise ratio is required to achieve this capacity?
ii. If a 3 MHz signal is to be transmitted in binary form over this channel, will it be suitable?

Question No.(2) (10 marks)

a. Compare each of the following pairs:
i. Digital signal - analog signal
ii. Attenuation - distortion
iii. Twisted-pair cables - coaxial cables

b. Find Fourier Series of the following signal, then sketch the spectrum of the signal (Use the first five components only)



Question No.(3) (10 marks)

a. Answer the following questions regarding the wireless transmission media
i. What are the advantages and disadvantages of microwave transmission?
ii. What are the differences between broadcast radio and microwave?
iii. What is the primary cause of signal loss in satellite communications?

b. A microwave transmitter has an output of 0.1 W at 2 GHz. Assume that this transmitter is used in a microwave communication system where the transmitting and receiving antennas are parabolas, each 1.2 m in diameter.
i. What is the gain of each antenna in decibels?
ii. Taking into account antenna gain, what is the effective radiated power of the transmitted signal?
iii. If the receiving antenna is located 24 km from the transmitting antenna over a free space path, find the available signal power out of the receiving antenna in dBm units.

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year

Data transmission
Mid-term Exam
Time: 1.5 hrs

Assume any missing data

2015

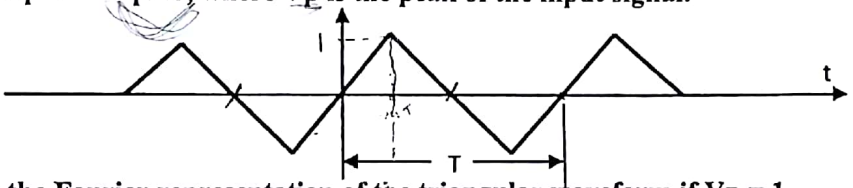
Question No.(1) (10 marks)

a. Define the following terms:
Channel capacity, modulation rate, scrambling, inter-symbol interference, total internal reflection.

b. Consider a series of transmission elements in which the input is at a power level of 4 mW, the first element is a transmission line with a 12-dB loss, the second element is an amplifier with a 35-dB gain, and the third element is a transmission line with a 10-dB loss.
i. Calculate the net gain/loss over the three elements.
ii. Calculate the output power at the end of the third element.

Question No.(2) (10 marks)

a. A periodic triangular waveform of 2500 Hz frequency is applied to a delta modulator which is working at a sampling rate that is 20 times the Nyquist rate. If the step size of the modulator is equal to Vp/10, where Vp is the peak of the input signal.



i. Calculate the Fourier representation of the triangular waveform if Vp = 1.
ii. Draw the block diagram of the delta modulator showing the resulted bit stream at the output.
iii. What will be the data rate of the resulted digital signal?
iv. If the resulted signal is encoded using Bipolar AMI and Manchester codes, draw the encoded pattern for each case over the time of a complete cycle of the analog waveform.
v. What are the advantages and disadvantages of the coded signal in each case?
vi. If it is required, apply the bipolar with 8-zeros substitution (B8ZS) scrambling on the Bipolar AMI. Draw the scrambled pattern.
vii. What is the minimum bandwidth required for the transmission of the signal in each case; Bipolar AMI and Manchester.

Question No.(3) (10 marks)

a. What are the transmission characteristics of each of the following frequency bands?

i. Radio range. ii. Microwaves. iii. Infrared.

b.
i. Draw the block diagram of the Quadrature Amplitude Modulation (QAM) modulator.
ii. If a 500 Mbps bit stream is applied to the input of a QAM modulator of four different amplitude levels, what will be the signaling rate at the output of the QAM modulator?
iii. For the advisor P = 110011 and the message D = 11100011, find the CRC frame which ensures the error detection.

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year

Data transmission
Mid-term Exam
Time: 1.5 hrs

Assume any missing data

Question No.(1) (10 marks)

a. Define the following terms

Transmission time, propagation delay, piggybacking, bit stuffing, modulation index.

b. A PCM encoder accepts a signal with a full-scale voltage of 10 V and generates 8-bit codes using uniform quantization. The maximum normalized quantized voltage is $1-2^{-8}$. Determine

i. Normalized step size,
ii. Actual step size in volts,
iii. Actual maximum quantized level in volts,
iv. The signal to quantization noise in dB.
v. If a 500 Hz analog signal is applied to the PCM system and is sampled at the minimum sampling rate, determine the data rate of the PCM output.

Question No.(2) (10 marks)

a. With the aid of the block diagram drawing, discuss the operation of the QPSK modulator. What will be the output of the modulator if the input data pattern is: 1011000111

b. Two stations communicate via a 1-Mbps satellite link with a propagation delay of 270 ms. The satellite serves merely to retransmit data received from one station to another, with negligible switching delay. Using HDLC frames of 1024 bits, determine

i. The bit length of the link.
ii. The transmission time of the frame.
iii. If the stop-and-wait flow control is used, what is the total time is required to transmit one frame and receive an acknowledgment?

Question No.(3) (10 marks)

a. Answer the following questions

i. What are reasons for breaking a long data transmission up into a number of frames?
ii. Discuss the operation of the Go-back-N ARQ.

b. In a data transmission scenario using the high-level data link control (HDLC) protocol, the first information frame is transmitted from station B to station A carrying a message from B to A in addition to a piggybacked acknowledgment of the fifth frame received from A. If the message carried by the frame is: 1011100101001101 and the address of the station A is 11001101, generate the 16-bit frame check sequence (FCS) field of the HDLC frame using the cyclic redundancy check (CRC) to be used at the other side in the error detection using a divisor of 1011101001000101

(2) clock one bit time in the stream.

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year

Data transmission
Mid-term Exam
Time: 1.5 hrs

Assume any missing data

Question No.(1) (10 marks)

a. What are the differences between each of the following pairs:
   i. QPSK and offset QPSK.
   ii. Synchronous and asynchronous transmission.
   iii. Transmission time and propagation time.

b. Assume that a telephone line channel is equalized to allow bandpass data transmission over a frequency range of 600 to 3000 Hz. The available bandwidth is 2400 Hz. For r = 1, evaluate the required bandwidth for
   i. 2400 bps QPSK.
   ii. 4800-bps eight level multilevel signaling (MPSK).
   iii. Is the bandwidth adequate?

Question No.(2) (10 marks)

a. With the aid of the block diagram drawing, discuss the operation of the QPSK modulator. What will be the output of the modulator if the input data pattern is: 1011000111

b. Suppose that a 500 kbps synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that have a drift of 1 minute in one year. Assume that the sampling at the receiver is ideally taken at the center of the bit and that the sender and receiver are resynchronized at the beginning of each frame.
   i. How long a sequence of bits can be sent before possible clock drift could cause a problem?
   ii. Repeat your answer in the case of that the data rate is changed to be 64 kbps.

Question No.(3) (10 marks)

a. Answer the following questions
   i. Why do we need to modulate the analog signals? briefly explain the forms of analog modulation.
   ii. Discuss the operation of the Go-back-N ARQ.

b. In a data transmission scenario using the high-level data link control (HDLC) protocol, the first information frame is transmitted from station B to station A carrying a message from B to A in addition to a piggybacked acknowledgment of the fifth frame received from A. If the message carried by the frame is: 1011100101001101 and the address of the station A is 11001101, Generate the 16-bit frame check sequence (FCS) field of the HDLC frame using the cyclic redundancy check (CRC) to be used at the other side in the error detection using a divisor of 10111011001000101

600 to 3000

(i) $B = 3000 - 600 = 2400$

(ii) for 2400 $BT = \left(\frac{1+r}{\log_2 M}\right) R = 2400$ Hz

(iii) $\left(\frac{1+r}{\log_2 M}\right) * R = \frac{2}{3} * 4800 = 3200$ Yes bandwidth exeed

2 / 365x24x60 / 0.

500 k bps

32bit / 16 bit

Minia University
Faculty of Engineering
Comp. & Sys. Engineering Dept., 3rd year

Data Transmission
Mid-term Exam
Time allowed: 90 minutes

Assume any missing data

Question 1

a- What are the transmission impairments which affect the signal quality on the transmission media and how it can be treated?

b- Draw the block diagram of the delta modulation system with explanation of its operation. What are the two types of noise appear in delta modulation and what are their causes?

Question 2

a- With the aid of drawing, explain the error detection process at the transmitter and receiver of a communication system. Give two examples of error detection techniques used in communication systems.

b- Consider a 1-Mbps link between two ground stations that communicate via a satellite relay. A geosynchronous satellite has an altitude of roughly 36,000 km. If the frame length of the data transmitted over this link is 8000 bits

i. Calculate the value of group delay over the link.
ii. Calculate the transmission delay of the frame.
iii. If the stop-and-wait flow control is used, after what time the transmitter can begin the transmission of the second frame?

Question 3

a- What are the criteria according to which we can evaluate or compare the various encoding techniques?

b- For a high-level data link control (HDLC) frame of 8000 bits information field, if the preamble and postamble fields are in the least possible lengths

i. Draw the prescribed HDLC frame structure.
ii. Calculate the percentage overhead per frame.
iii. To what type of transmission the HDLC belongs: synchronous or asynchronous?

With my best wishes

Minia University
Faculty of Engineering
Comp. & Sys. Engineering Dept., 3rd year

Data Transmission
Mid-term Exam
Time allowed: 90 minutes

Assume any missing data

Question 1

a- Compare between each pair of the following:
Data and signal, Fourier series and Fourier transform, bit rate and modulation rate.

b- A signal propagates on a transmission line at which the signal exposed to high attenuation. The voltage of the signal is measured at an arbitrary point P1 on the transmission line and after a distance of 10 Km it is measured again where the value decreased to the third of its value at P1. Calculate the attenuation in dB/Km.

c- Suppose that the spectrum of a channel is between 3 MHz and 4 MHz and its $SNR_{dB} = 24$.

- What is the capacity of this channel?
- If an analog signal with bandwidth of 1 MHz is sampled at the Nyquist rate and is required to be transmitted over this channel with 8-bits word for each sample, is the channel capacity is sufficient to carry this signal? Why?

Question 2

a- Give a brief classification of the transmission media used in the communications systems.

b- Draw the digital signal representation of the data pattern 0101100111001 in the following coding formats:

NRZI, Bipolar-AMI, Pseudoternary, Manchester, and Differential Manchester

Question 3

a- What is the quantization noise in PCM system and what are the two methods used to decrease its effect?

b- Draw the block diagram of the QPSK system stating the expression of the output function of the system. Draw the waveform of the output of the system if the input bit stream is 10110001 11.

With my best wishes

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year
Total Marks (105 Marks)

Data transmission
January, 2017
Code:EES 315
Time: 3 hrs

الامتحان مكون من ورقتين

Assume any missing data

Question No.(1) (20 marks)

a. Define the following terms:

Digital signal, transmission bandwidth, transmission time, channel capacity, wavelength division multiplexing (WDM), statistical TDM.

b. Briefly show the classification of the transmission media used in communications systems with mention of the advantages and limitations of each one.

c. Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white thermal noise, what signal-to-noise ratio is required to achieve this capacity?

Question No.(2) (20 marks)

a. What are the advantages of digital transmission of data over the analog transmission.

b. Given the binary bit stream 0100110001101 with bit duration T_b = 2 μsec. Assuming that the signal level for the preceding bit in the differential codes was negative.

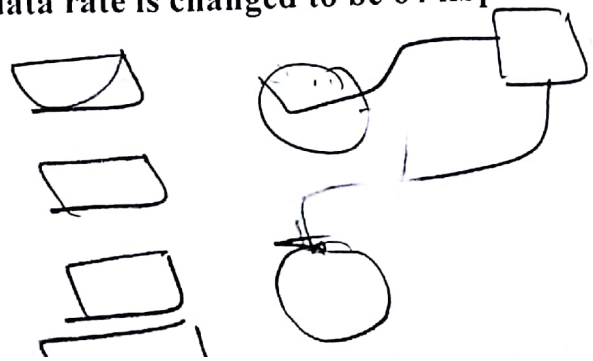
i. Encode the given binary stream using NRZI, Bipolar-AMI, and Differential Manchester.
ii. Show the advantages and disadvantages of each code in part (i).
iii. Calculate the modulation rate of the resulted encoded signals.
iv. If the binary bit-stream is applied to BFSK modulator that working at a carrier frequency f_c = 1 MHz and difference frequency f_d = 125 KHz, determine the frequency components resulted at the output of the BFSK modulator.
v. Determine the total bandwidth required for the signals resulted in part (iv).

Question No.(3) (20 marks)

a. Draw the block diagram of the delta modulator and demodulator with explanation of its operation.

b. Suppose that a 500 kbps synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that have a drift of 1 minute in one year. Assume that the sampling at the receiver is ideally taken at the center of the bit and that the sender and receiver are resynchronized at the beginning of each frame.

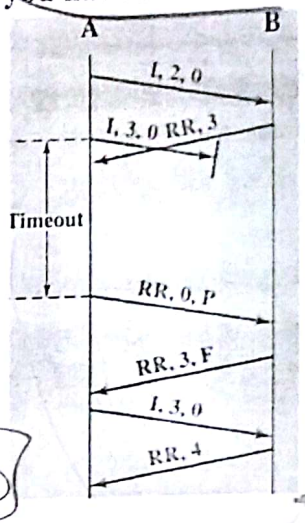
i. How long a sequence of bits can be sent before possible clock drift could cause a problem?
ii. Repeat your answer in the case of that the data rate is changed to be 64 kbps.



Question No.(4) **(20 marks)**

a. Discuss the meaning of flow control and the types of flow control that you have studied.

b. For the High-Level Data Link Control (HDLC) operation shown in figure, frames are exchanched between the two stations A and B. Assuming that the supervisory functions are encoded as (RR = 00, RNR = 01, REJ = 10, and SREJ = 11). Write the binary pattern of the 8-bit control field of each HDLC frame exchanged between the two stations.



Question No.(5) **(25 marks)**

a. ADSL is a modem technology designed to provide high-speed digital data transmission over the ordinary coaxial telephone cable.

i. What are the strategies on which the design of the ADSL based?
ii. Draw the configuration of the ADSL channel.
iii. Draw the Discrete Multitone (DMT) transmitter.

b. The information in four analog signals is to be multiplexed and transmitted over a telephone channel that has a 400- to 3100-Hz bandpass. Each of the analog baseband signals is bandlimited to 500 Hz. Design a communication system (block diagram) that will allow the transmission of these four sources over the telephone channel using

i. Frequency division multiplexing with SSB (single sideband) subcarriers.
ii. Time division multiplexing using PCM; assume 4-bit samples.

Show the block diagrams of the complete system, including the transmission, channel, and reception portions. Include the bandwidths of the signals at the various points in the systems.

==========The End of Questions==========

With My Best Wishes
Dr. Emad Tammam

Minia University
Faculty of Engineering
Comp. & Sys. Dept., 3rd year
Total Marks (105 Marks)

Data transmission
January, 2016
Code:EES 315
Time: 3 hrs

الامتحان مكون من ورقتين

Assume any missing data

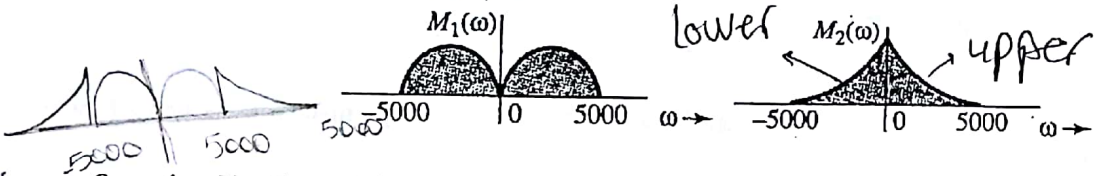
Question No.(1) (20 marks)

a. Define the following terms:

Digital signal, modulation rate, propagation time, full-duplex, piggybacking, statistical TDM.

b. Two signals $m_1(t)$ and $m_2(t)$, as shown in figure, are band-limited to 5000 rad/s and are to be transmitted using simultaneously over a channel using frequency division multiplexing (FDM). The double sidebands of the two signals are transmitted using the two sinusoidal carriers $2cos(10000t)$ and $2cos(20000t)$ respectively,

i. Sketch the spectra (frequency domain) of the two multiplexed signals on the channel.
ii. Locate the lower sideband and upper sideband of each signal.
iii. What must be the minimum bandwidth of the channel to carry the two signals simultaneously?



Question No.(2) (25 marks)

a. Briefly discuss the physical description and transmission characteristics of the following transmission media:

- Twisted pair
- Coaxial cable
- Optical fiber

b. A 5 km telephone line is known to have a loss of 4 dB/km. The input signal power is measured as 0.5 W, and the output noise level is measured as 4.5 μW. Using this information, calculate the output signal-to-noise ratio in dB.

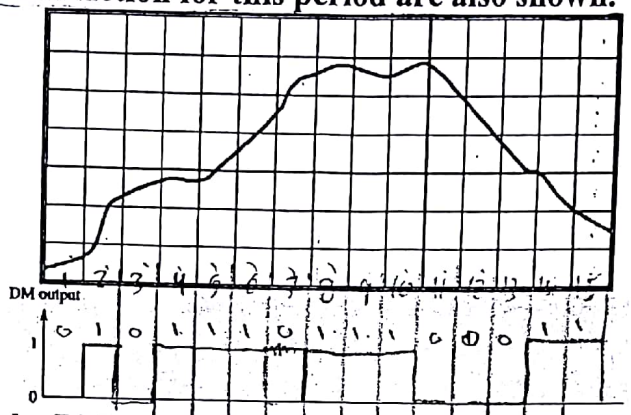
c. Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz.

i. Assuming white thermal noise, what signal-to-noise ratio (SNR) is required to achieve this capacity?
ii. If the bandwidth of the channel is halved to 1.5 MHz, how the intended capacity can be achieved under the same conditions of SNR obtained in part (i)?

Question No.(3) (20 marks)

a. List and briefly define important factors that can be used in evaluating or comparing the various digital-to-digital encoding techniques.

b. If the analog waveform shown in following figure is applied to a DM system of sampling period and step size as indicated by the grid on the figure. The first DM output and the staircase function for this period are also shown.



DM

i. Show the output of the DM system.
ii. If the data obtained in part (i) is to be digitally encoded, sketch the waveforms of the following codes: - NRZI - Bipolar-AMI - Manchester

Assume that the signal level for the preceding bit in the differential codes was negative.

Question No.(4) (20 marks)

2014

stop and wait
Go back N
selective reject

a. What are the three standardized versions of automatic repeat request (ARQ) used for error control?. Briefly explain the operation of each one.

b. Consider a 200-m optical fiber link operating at 1 Gbps. The velocity of propagation of optical fiber is typically about $3x10^8$ m/s. Assuming a frame of 8000 bits length is required to be transmitted over the link.

i. What is the value of propagation delay over this link?
ii. What is the transmission time of the frame?
iii. If the stop-and-wait flow control is used, what is the total time is required to transmit one frame and receive an acknowledgment?

Question No.(5) (20 marks)

a. ADSL is modem technology designed to provide high-speed digital data transmission over the ordinary coaxial telephone cable.

i. What are the strategies on which the design of the ADSL based?
ii. Draw the configuration of the ADSL channel.
iii. How the Discrete Multitone (DMT) is used with the ADSL?
iv. Draw the DMT transmitter.

reverse 25KHz
POTS 0:4HZ
Echo cancellation FDM
FDM upstream

b. Draw a block diagram for a TDM PCM system that will accommodate four 300-bps, synchronous, digital inputs and one analog input with a bandwidth of 500 Hz. Assume that the analog samples will be encoded into 4-bit PCM words.

The End of Questions

With My Best Wishes
Dr. Emad Tammam

2025 2000 1.000

J/J

L/B

Minia University
Faculty of Engineering
Computers & Systems Dept.
3rd year
Total Marks (105 Marks)

Data transmission
January, 2015
Code: EES 315
Time: 3 hrs

الامتحان مكون من ورقتين

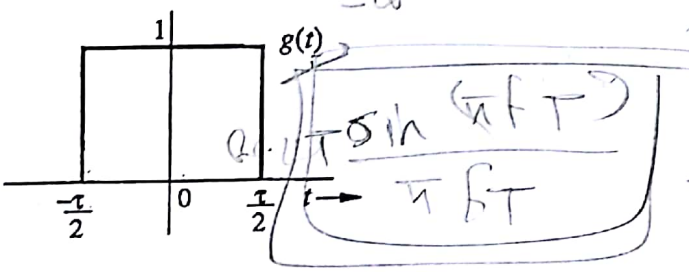
Assume any missing data

Question No.(1) (20 marks)

a. Show the difference between each pair of the following terms:

i. Analog signal & digital signal.
ii. Half duplex & full duplex.
iii. Data rate & modulation rate.
iv. Synchronous transmission and asynchronous transmission.

b. Find Fourier transform of the following signal:



Question No.(2) (20 marks)

a. Discuss the classification of the transmission media used in communication systems. Write short notes about the following parameters for each medium:

- Physical description.
- Transmission characteristics.

b. Consider an audio signal with spectral components in the range 300 to 3400 Hz. Assuming that the signal is sampled at the Nyquist rate to generate a PCM signal

i. For SNR = 30 dB, what is the number of uniform quantization levels needed?
ii. What data rate is required?

Question No.(3) (20 marks)

a. For the bit stream 0101001110, sketch the waveforms of the following codes:

- NRZI
- Bipolar-AMI
- Manchester

Assume that the signal level for the preceding bit in the differential codes was negative.

b. Suppose that a 500 kbps synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that have a drift of 1 minute in one year. Assume that the sampling at the receiver is ideally taken at the center of the bit and that the sender and receiver are resynchronized at the beginning of each frame.

i. How long a sequence of bits can be sent before possible clock drift could cause a problem?
ii. Repeat your answer in the case of that the data rate is changed to be 64 kbps.

Question No.(4) **(20 marks)**

a. Discuss the forms of the flow control used in communication systems showing the advantages and disadvantages of each one.

b. Two ground stations communicate via a 1-Mbps satellite link where the satellite is placed at a height of 36000 Km. The satellite serves merely to retransmit data received from one station to another, with negligible switching delay. Knowing that the velocity of the electromagnetic wave is typically about $3x10^8$ m/s in free space and if HDLC frames of 1024 bits length is used in this communication system, determine:

i. The propagation delay over this link.
ii. The transmission time of the frame.
iii. If the stop-and-wait flow control is used, what is the total time required to transmit one frame and receive its acknowledgment at the transmitter?

Question No.(5) **(25 marks)**

a. ADSL is modem technology designed to provide high-speed digital data transmission over ordinary telephone wire.

i. What are the strategies on which the design of the ADSL based?
ii. Draw the configuration of the ADSL channel.
iii. How the Discrete Multitone (DMT) is used with the ADSL?
iv. Draw the DMT transmitter.

b. Consider that there are 11 sources (analog and digital) to be multiplexed on a single link of 64 kbps. Design the transmitter of the communication system required to multiplex this number of signals using the synchronous TDM (draw the block diagram showing the data rate at each point), where the sources are as follow:

Source 1: Analog, 1-kHz bandwidth
Source 2: Analog, 2-kHz bandwidth
Source 3: Analog, 2-kHz bandwidth
Sources 4–11: Digital, 3200 bps synchronous

The End of Questions

2014

Minia University
Faculty of Engineering
Comp. & Sys. Engineering Dept., 3rd year

Data transmission
Final Exam
Time allowed: 3 hours

Assume any missing data

Question 1

a. Define the following terms:
Digital signal, modulation rate, transmission time, propagation delay, bit stuffing

b. Draw the block diagram of the QPSK system stating the expression of the output function of the system. Draw the waveform of the output of the system if the input bit stream is 1011000111.

Question 2

a. What is the difference between each of the following pairs:
i. Periodic signal and aperiodic signal.
ii. Fourier series and Fourier transform.
iii. Synchronous transmission and asynchronous transmission.

b. For the bit stream 01001110, sketch the waveforms for each of the following codes

NRZI, Bipolar-AMI, Pseudoternary, Manchester, and Differential Manchester

Assume that the signal level for the preceding bit for NRZI was high; the most recent preceding 1 bit (AMI) has a negative voltage; and the most recent preceding 0 bit (pseudoternary) has a negative voltage.

Question 3

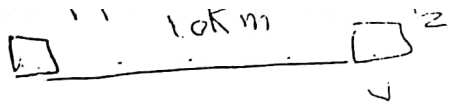
a. The most common error control techniques are based on some scenarios which are referred to as automatic repeat request (ARQ).
i. What are these scenarios?
ii. With brief discussion, what are the versions of ARQ?

b. Consider an audio signal with spectral components in the range 300 to 3000 Hz. Assume that a sampling rate of 7000 samples per second will be used to generate a PCM signal.
i. For SNR = 30 dB, what is the number of uniform quantization levels needed?
ii. What is the capacity of the channel required to carry this signal?

Question 4

a. Write short notes showing the advantages and disadvantages of each of the following transmission media
i. Twisted pair.
ii. Coaxial cable.
iii. Optical fiber

10



$$\text{attenuation} = \frac{\text{gain}}{\text{distance}} = 10\log_{10}\frac{P_1}{P_{1/3}} = 10\log 3 = 4.77 \text{ dB/Km}$$

(b) **A digital signal propagates on a high attenuation transmission line. The power of the signal is measured at an arbitrary point (P1) on the transmission line and after a distance of 10 Km it is measured again. At the second point, it is found that the power decreased to the third of its value at P1.**

i. **Calculate the attenuation in dB/Km.**
ii. **How could we compensate for the attenuation effect to improve the signal quality.**
iii. **If the signal is analog, how could we decrease the attenuation effect?**

Question 5

a. **Draw the frame structure of the high-level data link control (HDLC) with explanation of the function of each data field.**

(b.) **Consider a 200-m optical fiber link operating at 1 Gbps. The velocity of propagation of optical fiber is typically about 3×10^8 m/s. Assuming a frame of 8000 bits length is required to be transmitted over the link.**

i. **What is the value of propagation delay over this link?**
ii. **What is the transmission time of the frame?**
iii. **If the stop-and-wait flow control is used, what is the total time is required to transmit one frame and receive an acknowledgment?**
iv. **Repeat i, ii, and iii if the frame size become 500 bits. What is your comment on the results.**

With my best wishes

Propagation delay $a = \frac{B}{L}$ $\quad B = R\frac{d}{V} \Rightarrow 1\times10^9 * \frac{200}{3\times10^8} = \frac{2000}{3} = 666.$

$$a = \frac{666.66}{8000} = 0.083 \qquad \boxed{0.08 < 1}$$

iv $a \Rightarrow \frac{666.66}{500} = \boxed{1.3 > 1}$

HDLC

flag	Addr	Cont	Inf.	FCS	flag