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

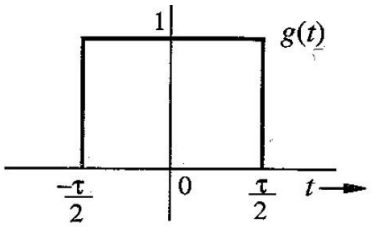
Assume any missing data Question No.(1)

(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. 1

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*==========

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

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

الامتحان مكون من ورقتين

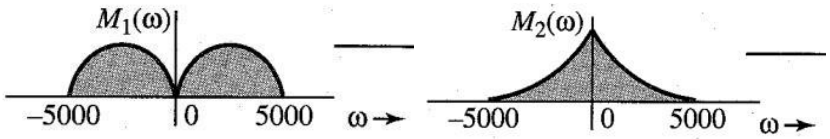
Assume any missing data

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 $2\cos(10000t)$ and $2\cos(20000t)$ 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.

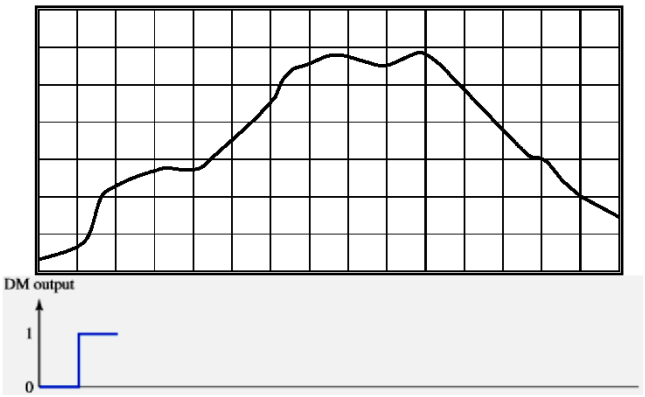
c. Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz.

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.



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)

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.

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*

Minia University
Faculty of Engineering
Computers & Systems 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.

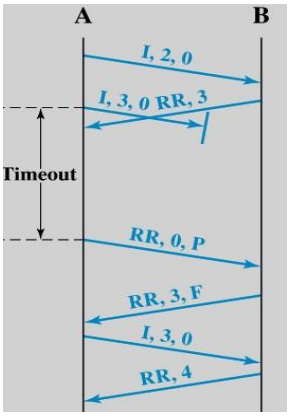
b. Suppose that a 500 kbps synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that have a drift of 1 minute in one year. Assume that the sampling at the receiver is ideally taken at the center of the bit and that the sender and receiver are resynchronized 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
Computers & Systems Dept.
3rd year
Total Marks (105 Marks)

Data transmission
January, 2018
Code: EES 315
Time: 3 hrs

الامتحان مكون من ورقتين

Assume any missing data

Question No.(1) **(20 marks)**

a. Define the following terms:

Spectrum of a signal, channel capacity, propagation delay, piggybacking, statistical TDM

b. What are the advantages of digital transmission of data over the analog transmission?

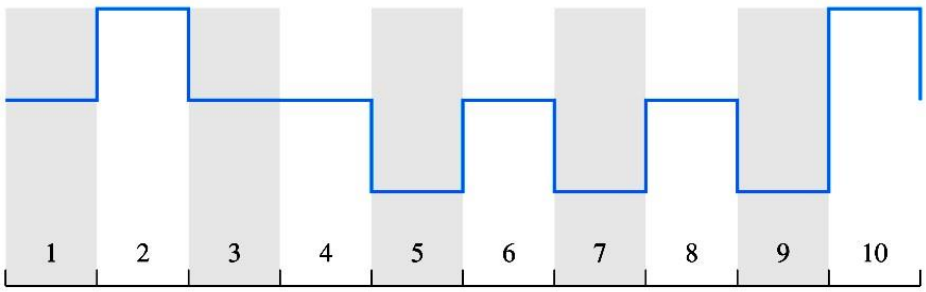
c. A 12 km telephone line of a total loss equal to 20 dB is fed by an input signal power of 0.5 W. If an amplifier with power gain of 10 dB is used each 2 km, calculate the output signal power in dB.

Question No.(2) **(20 marks)**

a. Briefly, discuss the guided transmission media used in communication systems showing the transmission characteristics of each on.

b. The waveform shown in the following figure represents a coded binary sequence which is transmitted over a noisy channel. If the figure shows the received waveform at the receiver,

i. Suggest an encoding technique that may be used at the transmitter to obtain such a waveform?
ii. Show the advantages and disadvantages of the suggested encoding technique. iii. What is the effect of the noisy channel on the waveform and how can this effect be recovered? iv. What do you expect the binary sequence that was encoded into the shown waveform at the transmitter?



Question No.(3) **(20 marks)**

a. Draw the block diagram of the delta modulator and demodulator showing

i. the operation of the modulator and demodulator. ii. the advantages and disadvantages of the system.

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. With the aid of drawing, explain the operation of the error detection process. Give two examples for the error detection techniques used in communication systems with brief description of the operation of each one.

b. Assume that the primary HDLC station in NRM has sent six I-frames to a secondary. The primary's N(S) count was three (011 binary) prior to sending the six frames. If the poll bit is on in the sixth frame, what will be the N(R) count back from the secondary after the last frame? Assume error-free operation.

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

a. Answer the following questions about the multiplexing:

i. Draw the block diagram of the frequency division multiplexing (FDM) system with explanation of its operation. ii. If twenty-four voice signals are to be multiplexed using FDM and transmitted over twisted pair. What is the bandwidth required for FDM? iii. If the twenty-four voice signals, mentioned in (ii) are to be multiplexed using TDM and transmitted where the ratio of data rate to transmission bandwidth of the channel is 1 bps/Hz, what is the bandwidth required for TDM using PCM?

b. A TDM PCM system is required to multiplex four 300-bps, synchronous, digital inputs and one analog input with a bandwidth of 500 Hz. Assuming that the analog samples will be encoded into 4-bit PCM words, design the TDM system showing the scanning frequency of the multiplexer and the data rate at each point in the block diagram.

========== **End of Questions**==========

With My Best Wishes
Dr. Emad Tammam

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

Data transmission
January, 2019
Code: EES 315
Time: 3 hrs

الامتحان مكون من ورقتين

Assume any missing data

Question No.(1) (20 marks)

a. Check each of the following sentences as (✓) for the true and (×) for the false showing the reason of your choice in the case of the false sentences:

1. **Spectrum of a signal is just the range of frequencies occupied by the signal .....( )**
2. **In any bandlimited signal, the highest frequency component propagates at a faster velocity than the center frequency component .....( )**
3. **Digital binary signal requires more bandwidth for transmission than the analog signal ( )**
4. **Output data rate of the QPSK modulator is half the data rate at its input ….....( )**
5. **FSK have the largest transmission bandwidth compared to ASK and PSK .....( )**
6. **The modulation rate in the binary-FSK is equal to the data rate ...……..……...……( )**
7. **The preferred error control in the case of satellite link is to retransmit the frames that arrives the destination in error .....( )**
8. **Manchester encoding is the best choice in the case of the limited bandwidth channel ..( )**
9. **The advantage of TDM is that it is suitable for either analog or digital signaling .....( )**
10. **The statistical TDM is more cost-efficient than the synchronous TDM .....( )**

b. A 12 km telephone line of a total loss equal to 20 dB is fed by an input signal power of 0.5 W. If an amplifier with power gain of 10 dB is used each 2 km, calculate the output signal power in dB.

Question No.(2) (20 marks)

a. Briefly, discuss the transmission characteristics of the guided transmission and unguided transmission media used in communication systems showing the main applications of each one.

b. Consider a channel with a 1-MHz capacity and an SNR of 63.

i. **What is the upper limit to the data rate that the channel can carry?**

ii. **The result of part (i) is the upper limit. However, as a practical matter, better error performance will be achieved at a lower data rate. Assume we choose a data rate of 2/3 the maximum theoretical limit. How many signal levels are needed to achieve this data rate?**

Question No.(3) **(20 marks)**

a. Make a comparison between the different digital-digital encoding techniques based on the factors used to differentiate between them.

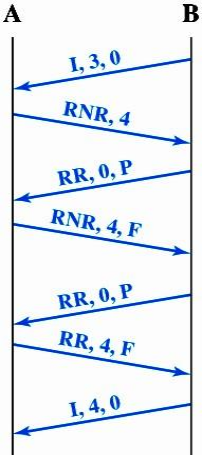
b. Suppose that a 500 kbps synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that have a drift of 1 minute in one year. Assume that the sampling at the receiver is ideally taken at the center of the bit and that the sender and receiver are resynchronized 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. Explain the operation of the three standardized versions of automatic repeat request (ARQ) used for error control?

b. For the High-Level Data Link Control (HDLC) operation shown in figure, frames are exchanged between the two stations A and B. Assuming that the supervisory functions are encoded as (RR = 00, RNR = 01, REJ = 10, and SREJ = 11).



i. Explain the scenario shown in figure.

ii. 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. Ten 4-KHz voice signals are sampled at the minimum sampling rate and encoded using 8bit encoder to be multiplexed in byte-interleaving fashion using TDM.

i. What is the scanning speed required to multiplex the ten voice signals?
ii. If a one bit is used at the beginning of each frame for synchronization, determine the data rate of the resulted TDM signal?
iii. What is the time duration of the voice channel inside the TDM frame?
iv. If a sequence of 30 bits is used for synchronization adjustment, determine the maximum possible time period required for the framing search mode to reset the synchronization

========== **End of Questions** ==========

With My Best Wishes,
Dr. Emad Tammam
January, 2019

Minia University **Data transmission**
Faculty of Engineering **Mid-term Exam, 2017 Comp.**
& Sys. Dept., 3rd year **Time: 1.5 hrs.**

Assume any missing data

Question No.(1) **(12 marks)**

a. Define the following terms:

Digital signal, full-duplex, channel capacity, Effective bandwidth, scrambling

b. Answer the following questions about the delay distortion

i. What is the delay distortion?

ii. What is the main cause of delay distortion and what is its effect on the transmitted signal?

iii. How can the effects of the delay distortion be treated?

c. A 200 Hz sinusoidal signal of 5 volts peak voltage is applied to a half-wave rectifying circuit that uses an ideal diode to obtain a half-wave rectified signal at the output.

i. Draw the spectrum of the half-wave rectified signal obtained at the output of the rectifier.

ii. If the half-wave signal is applied to a filter to pass only the fundamental component, what should be the bandwidth of the filter? Draw the output of the filter in time-domain.

iii. If we want to transmit the spectrum of the half-wave signal from DC up to the fifth harmonic as a digital signal in the binary form through a communication system, what is the capacity of the channel required to carry the signal?

Question No.(2) **(8 marks)**

a. Briefly, discuss the wireless transmission bands used in communication systems showing the transmission characteristics of each band.

b. The audio power of the human voice is concentrated at about 300 Hz. Antennas of the appropriate size for this frequency are impracticably large, so that to send voice by radio the voice signal must be used to modulate a higher (carrier) frequency for which the natural antenna size is smaller.

i. What is the length of an antenna one-half wavelength long for sending radio at 300 Hz?

ii. An alternative is to use a modulation scheme for transmitting the voice signal. Suppose we would like a half-wave antenna to have a length of 1 meter. What carrier frequency would we use?

Question No.(3) **(10 marks)**

a. Answer the following:

i. What is the differential encoding and what are its benefits? Give two examples of differential encoding.

i. Draw the block diagram of the Quadrature Amplitude Modulation (QAM) modulator.

ii. A standard 9600 bps modem uses 12 phase angles, four of which have two amplitude values, what will be the signaling rate at the output of the modem?

b. A human voice signal is sampled at the minimum sampling rate then encoded into a binary signal using 7-bit encoder

i. What will be the required bandwidth for the digital signal on the channel?

ii. If the signal is transmitted as SSB AM signal, what will be the required bandwidth? iii. Which of the transmission forms mentioned in (i) and (ii) is more advantageous to be used? Why?

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 P_1 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 P_1. 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 1011000111.

With my best wishes