1. Closed books and closed notes.
2. Any additional information required is attached to the test. You can only use the four-page cheat sheet handout.
3. Please show all the steps in your work and attach the worksheets to the test.
4. You may work problems in any order.
5. Please print your name and last four digits of your ID.
6. Write on one side of the paper only.
7. Choose any one answer from the options given and write down the index in the box provided.
8. No cheating.
9. All questions carry equal weights (5 points) except Q5 and Q14 (10 Points).

NAME:

STUDENT ID#:  
(last 4 digits)

COURSE NO: _____ 4330 _____ 5361  
(Check one)
1) A signal cannot be simultaneously time-limited and band-limited.

   a) True
   b) False

2) To prevent aliasing in the sampled signal, the antialiasing filter should be applied

   a) Before sampling
   b) After sampling

3) The audio signal has a BW of 3.8KHz and is sampled at a rate of 8KHz which is significantly higher than the Nyquist sampling rate. The reason for that is:

   a) To avoid unrealistic filters required for signal reconstruction.
   b) To prevent aliasing.
   c) Both a and b.
   d) None of the above.

4) Which of the following statements is not true regarding digital communication:

   a) Regenerative repeaters can be used in digital communications.
   b) Digital communication is more susceptible to noise than analog communication.
   c) Digital signals are easy to multiplex.
   d) Digital communication is more efficient in realizing the exchange of SNR for BW

5) A signal m(t) band-limited to 3 KHz is sampled at a rate 33 1/3% higher than the Nyquist rate. The maximum acceptable error (the maximum quantization error) is 0.5% of the peak amplitude m_p. The quantized samples are binary coded.

   a) Find the sampling rate for the signal.
   b) Find the number of levels actually used by the quantizer.
   c) Find the minimum BW of a channel required for transmitting a binary coded signal.
6) The figure below shows a DPCM system.

What part of the DPCM system introduces noise in the digital signal?

a) Quantization  
b) Prediction  
c) Adder  
d) None of the above

7) Delta Modulation exploits sample correlation by over sampling as oversampling leads to smaller prediction error. The reason for smaller prediction error is:

a) Closer the samples of the signal, more is the correlation among them.  
b) Farther the samples of the signal, less is the correlation among them.  
c) Oversampling reduces quantization error.  
d) None of the above

8) A Signal has average power equal to 200 Watts. Give the signal power in:

a) dBW (dBwatt)  

b) dBm (dBmilliwatt)
9) One of the criteria, for a distortionless transmission of the signal through a linear, time-invariant, continuous-time system, is that the slope of the phase response of the system, with respect to ω, should be

a) negative of the peak amplitude of the input signal.
b) negative of the delay of the output with respect to the input signal.
c) negative of the frequency of the input signal.
d) none of the above.

10) The frequency response of a linear system is shown in the figure below. Choose the one which is TRUE with respect to distortionless transmission of the signal through such a system.

a) The filter can transmit low frequency signals (ω < ω0) with negligible distortion.
b) The filter can transmit high frequency signals (ω > ω0) with no distortion.
c) The filter can transmit all the frequencies with negligible distortion.
d) None of the above.

11) If a linear channel has non-ideal characteristics (non-ideal frequency response), the received pulse signal will have dispersions (spreading). If you were to choose a system to avoid interference in the system, which one would you choose?

a) FDM
b) TDM
c) CDMA
d) None of the above.

12) Choose the channel, which does not cause Frequency Selective Fading of the transmitted signals.

a) Troposcatter Channels
b) Channels using ionosphere
c) Cable having impedance irregularities.
d) None of the above.
13) Which of the following signals has the highest energy?

\[ m(t) \cos \omega_c t \]

a) Signal A  
b) Signal B  
c) Both the signals have equal energy.  
d) Provided information is insufficient.

14) A RC low pass circuit is given below

The PSD of the input voltage is given below

\[ S_x(o) = 2 \delta(o-\frac{\pi}{2}) + \delta(o+1) + \delta(o+1) \]

A) The input signal power is given as

a) \( \frac{1}{\pi} \)  
b) \( \frac{2}{\pi} \)  
c) \( \frac{3}{\pi} \)  
d) \( \frac{4}{\pi} \)
B) The output signal power is given as

a) 1.1/π
b) 1.2/π
c) 1.3/π
d) 1.4/π

15) A random binary sequence is as follows
   1100111
You are asked to use a line code such that the resulting signal should have a dc null, single error-detection capability, lower bandwidth and should be transparent. Which one would you choose?

a) Polar NRZ signaling
b) On-Off RZ signaling
c) Bipolar RZ signaling
d) HDB signaling

16) The pulses in bipolar signaling are spaced 5 x 10^-8 seconds apart. What is the required bandwidth to transmit this signal? (Consider full pulse width)

a) 200 KHz/sec
b) 400 KHz
c) 250 Hz
d) None of the above.

17) For the same noise immunity, if the polar signaling uses pulses of amplitudes 1 and -1, then on-off signaling should use pulses of amplitudes

a) 1 and 0
b) 2 and 0
c) 3 and 0
d) 4 and 0
18) The signal $m_1(t)$ has a BW of $B1$ Hz and $m_2(t)$ has a BW of $B2$ Hz. Now consider signal $m_3(t) = m_1(t) \times m_2(t)$. What is the minimum sampling frequency needed for $m_3(t)$ for exact reconstruction.

a) $B1+B2$ Hz  
b) $2(B1-B2)$ Hz  
c) $2(B1\times B2)$ Hz  
d) $2(B1+B2)$
Some line codes: (a) On-off (RZ). (b) Polar (RZ). (c) Bipolar (RZ). (d) On-off (NRZ). (e) Polar (NRZ)

ON-OFF (RZ)

POLAR (RZ)

BIPOLAR (RZ)

ON-OFF (NRZ)

POLAR (NRZ)

PSD of bipolar, polar and split phase signals normalized for equal powers (using half width rectangular pulses).