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2007-05-04

Quiz Simulation of Telesystems

Time: Maximum 40 minutes
Tools*:* No calculator, no notes.
Requirement: 50% for approval.

You only have to present the answers. No motivations or calculations are required.

Good luck!

/Magnus

Name: ____

Start time: ____________________ Stop time: _____________________________

1. Combine a description in the left column with a term or value in the right column. State what number that is associated with which letter, in numerical order. There is a one-to-one relationship.

1. Source coding	A. Base workspace.
2. A complex signal $Z(t) = I(t)+jQ(t)$, where j is the imaginary unit, $I(t)$ is the inphase message signal (information signal) and $Q(t)$ is the quadrature phase message signal, to be modulated by a sine wave and cosine wave respectively, both at the carrier frequency.	B. OFDM
3. Makes it possible to combat frequency selective fading without complex equalization, since the fading can be considered as flat within each sub-channel, and an error correcting code can handle that some of the sub-carriers are exposed to severe fading. Due to the long symbol length, we can afford to introduce a long guard interval between the symbols, in view to eliminate inter-symbol interference.	C. Bit interleaving
4. A Simulink model where different signals have different sample frequency or bit rate.	D. Base-band representation
5. A time diversity technique. The order of the bits is changed on the sender side, and reordered on the receiver side, in view to spread burst errors in time and make it easier for the FEC to correct the errors.	E. FSK (or 2FSK).
6. Formula for the calculation of the channel capacity, i.e. the maximum possible net bit rate for an ideal channel code and a given channel bandwidth and signal-to-noise ratio.	F. Crosstalk
7. Utilized in for example CDMA2000 and WCDMA. Each bit is multiplied by a spreading code, resulting in a chip sequence. The chip rate divided by the bit rate is the spreading factor.	G. The Nyquist theorem

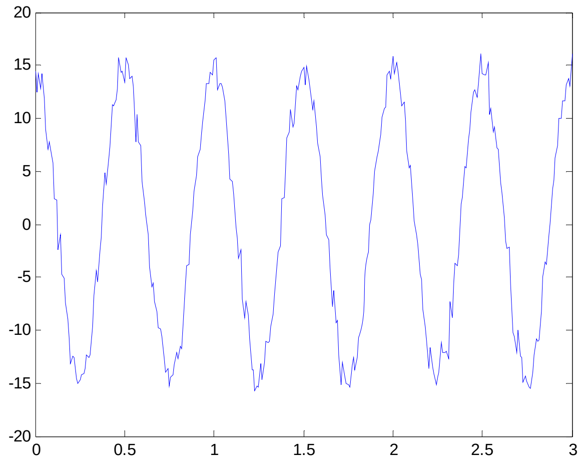
8.	Arrays (variables) that are seen from a Matlab script and the command prompt, as opposed to local variables of a Matlab function.	H.	Shannon theorem (or Shannon-Heartly theorem)
9.	Conventional modulation method that is less bandwidth efficient but more robust to noise than QPSK.	I.	Equalizer
10.	Common channel model. The noise is added to the useful signal. The noise is assumed to be generated by a random process where the voltage levels are normally (or Gaussian) distributed. The noise spectral power density is constant over the whole studied frequency band.	J.	Direct sequence spread spectrum
11.	The distribution of the Matlab random number generation function *rand()*.	K.	Multirate
12.	Conventional modulation method that gives higher bit rate over a given bandwidth than QPSK, but may result in higher BER.	L.	AWGN
13.	Adaptive filter that compensates for non-flat channel, for example frequency selective fading and phase shift.	M.	Uniform
14.	Based on a frame consisting of a fixed number of timeslots, one per channel. Utilized in for example GSM.	N.	Frequency hopping.
15.	A form of spread spectrum. Utilized for example in Bluetooth. The number of utilized frequency channels is the spreading factor.	O.	Rician
16.	Common model for the distribution of the amplitudes in case of fading with a dominant path, for example a line-of-sight signal.	P.	Rayleigh
17.	Common model for the distribution of the amplitudes in case of fading without a dominant path but with a large amount of echoes.	Q.	16QAM
18.	Co-channel interference.	R.	The absolute value.
19.	Formula that states the required sample rate for a given bandwidth to avoid aliasing.	S.	Digitalization and compression.
20.	Distance to origin of a complex value.	T.	TDMA

(20 points)

Answer:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 .

Answer: 1S 2D 3B 4K 5C 6H 7J 8A 9E 10L 11M 12Q 13i 14T 15N 16o 17P 18F 19G 20R



2. Consider the above plot, generated by the following Matlab script.

a) Fill in the four missing values on the lines in the script: (4 points)

```
t = _____:0.01: _____;                          % Time vector
s = 14.4*sin(2*pi*_____*t + pi/_____); % Useful signal.
n = randn(1,length(t));                         % Noise.
plot(t,s+n);
S=var(s);                                       % Signal power.
N=var(n);                                       % Noise power.
SNR = 10*log10(S/N)                             % SNR in dB.
```

Answer: Write 0, 3, 2 and 2 respectively.

b) The script calculates a SNR value in decibel, which will differ slightly from the expected value, and will be different everytime the script runs, due to randomnesss. If we don't find the SNR value sufficiently accurate, but want to increase the number of simulated samples by a factor 10, how should the code be modified without changing the plot axis scaling? (2 points)

Answer: _ ____

Answer: Write `t = 0:0.001:3;` on the first line.

c) What SNR value in decibel will approximately be calculated in the last row? -10, -6, 0, 6, 20 or 30? (4 points)

Hints:
The function `randn(M,N)` generates an M by N matrix of Normal (or gaussian) distributed random numbers, with mean value 0 and variance 1, corresponding to a power of 1. The function `var(x)` estimates the variance of x (the square of the standard deviation) which corresponds to the power if the mean value is 0. The power of a sine wave with amplitude *A* Volt is $(A/1.44)^2$ $Volt^2$ (because the power in $Volt^2$ is the square value of the RMS voltage, and the RMS voltage of a sinewave is the the amplitude divided by square root of 2, which is 1.44).

Answer: __ ____ __

Correct answer: 20 dB.