# NOISE IN RADIO COMMUNICATIONS - QUIZ - 5.2.2017

1. At which frequency f=? the shot-noise spectral power density equals the Rayleigh-Jeans approximation for thermal noise? The temperature of all equipment used is equal to T=20°C. ($h=6.626\cdot10^{-34}$Js, $k_B=1.38\cdot10^{-23}$J/K, $c=3\cdot10^8$m/s)

(A) 22GHz (B) 510GHz (C) 6.1THz (D) 231THz

2. What noise power $P_N$=? is available at the connector of a lossless antenna pointed to a black-body ($\Gamma$=0) target at T=2000K? The antenna operates at a center frequency of $f_0$=10GHz, its bandwidth equal to $\Delta f=10\%f_0$. ($k_B=1.38\cdot10^{-23}$J/K)

(A) 28pW (B) 4.0pW (C) $1.4\cdot10^{-14}$W (D) $2.8\cdot10^{-20}$W

3. What is the noise temperature $T_A$=? of a lossless antenna with a directivity of D=30dBi pointed to the Sun? The Sun has an angular diameter of $\alpha_S$=0.5° and radiates as a black body at $T_S=10^6$K. The cold-sky background is at $T_N$=10K.

(A) 486K (B) 4770K (C) 10K (D) $10^6$K

4. A monolithic IC manufacturing process allows transistors with a gain of G=7dB and noise temperature of T=400K at room temperature at a frequency f=50GHz. What noise temperature $T_{RX}$=? can achieve a receiver built in the above-mentioned technology?

(A) 200K (B) 300K (C) 400K (D) 500K

5. What is the G/T figure of merit of a satellite ground station with a lossless antenna temperature of $T_A$=25K and a receiver with a noise figure of F=0.5dB? The antenna gain is equal to G=40dBi. ($T_0$=290K)

(A) 2.2dB/K (B) 22.2dB/K (C) 37.8dB/K (D) 57.8dB/K

6. A low-noise front end has to be designed for a K-band satellite receiver operating at f=20GHz. Which of the following device technologies is best suited for the low-noise front end?

(A) N-channel MOSFET (B) Si PNP (C) GaAlAs HEMT (D) SiGe HBT

7. A hot/cold ratio Y=3dB is obtained while measuring an unknown high-gain amplifier with a noise head having the hot temperature $T_2$=1000K and cold temperature $T_1=T_0$=290K equal to room temperature. What is the noise temperature T=? of the amplifier?

(A) 420K (B) 65K (C) 1000K (D) 290K

8. What is the required signal-to-noise ratio S/N=? in a radio link using BPSK modulation to obtain a $BER=10^{-9}$? The real-world demodulator loss amounts to a=2dB when compared to an ideal BPSK demodulator.

(A) -1.6dB (B) 10.6dB (C) 12.6dB (D) 14.6dB

9. The local oscillator of a satellite TV receiver operates at $f_{LO}$=10.5GHz and includes a Q=1000 dielectric resonator coupled to an active device. Which of the following semiconductor devices is best suited for this purpose?

(A) GaAlAs HEMT (B) avalanche diode (C) N-channel MOSFET (D) Si NPN

10. An oscillator for $f_0$=20MHz uses a LC circuit with a $Q_L$=30. What improvement of the oscillator phase noise L($\Delta$f) is expected at an offset of $\Delta f$=300Hz when the LC circuit is replaced with a quartz crystal wit a $Q_L$=3000?

(A) 40dB (B) 30dB (C) 20dB (D) 10dB

11. A simple LC oscillator ($Q_L$=10) for $f_0$=300GHz is built as a technology demonstrator for a SiGe process with a noise figure of F=10dB. What spectral-line width $f_{FWHM}$=? is expected at an operating power of $P_0$=-10dBm? ($k_B=1.38\cdot10^{-23}$J/K, $T_0$=290K)

(A) 28MHz (B) 280kHz (C) 2.8kHz (D) 28Hz

12. A binary shift register includes m=17 D-flip-flops connected into a chain. The maximum sequence length that can be produced by a linear feedback network including only EXOR gates is equal to N=?

(A) 65535 (B) 65536 (C) 131071 (D) 131072

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