

## 2. tiha vaja iz VISOKOFREKVENČNE TEHNIKE - 11.11.2016

1. Močnostni VF tranzistor ima skupno elektrodo na prirobnici za hladilno rebro.  $\Omega$ -meter kaže, da ena od ostalih dveh elektrod tvori usmerniški spoj, druga pa ima proti skupni elektrodi nizko upornost  $R < 1\Omega$ . Tranzistor je:

- (A) NPN skupna B (B) močnostni GaAs FET (C) močnostni LDMOS (D) NPN skupni E

2. Visokofrekvenčni detektor vsebuje Schottky diodo z nizkim pragom  $U_{1mA}=100mV$ . Pri vhodnem visokofrekvenčnem signalu moči  $P=+30dBm$  bo odziv detektorja naslednja funkcija  $U(P)$ , kjer moč  $P$  vstavimo v [W] in je  $\alpha$  sorazmernostna konstanta z merskimi enotami:

- (A)  $U=\alpha \cdot P$  (B)  $U=\alpha \cdot P^2$  (C)  $U=\alpha \cdot \sqrt{P}$  (D)  $U=\alpha \cdot P^{3/2}$

3. Neznano dvovhodno vezje (četveropol) opisuje naslednja matrika s parametrov  $S_{11}=0$ ,  $S_{12}=3j$ ,  $S_{21}=-3j$  in  $S_{22}=0$ . Neznano vezje ima naslednje električne lastnosti (obkrožite NAPACEN odgovor!):

- (A) brezpogoj.stabilno (B) nesimetrično (C) nerecipročno (D) aktivno

4. Koaksialni kabel s polietilenskim dielektrikom  $\epsilon_r=2.25$  ima karakteristično impedanco  $Z_k=50\Omega$ . Pri kateri najmanjši dolžini kabla  $l=?$  se breme  $Z=(20+j0)\Omega$  preslika v popolnoma delovno impedanco  $Z'=R'+j0$  pri frekvenci  $f=100MHz$ ? ( $c_0 \approx 3 \cdot 10^8 m/s$ )

- (A) 33.3cm (B) 25cm (C) 75cm (D) 50cm

5. Ojačevalnik z bipolarnim tranzistorjem je samo pogojno stabilen zaradi  $C_{BK}=C_{MILLER}>0$ . Kateri od navedenih ukrepov za doseganje brezpogojne stabilnosti NE znižuje ojačanja?

- (A) uporovna povratna vezava (B) obremenitev izhoda z uporom (C) nevtralizacija v simetrični vezavi (D) vezava s skupno bazo

6. Veliko usmerjeno anteno zasukamo v Sonce, da njena šumna temperatura naraste na  $T_A=20000K$ . Kolikšna šumna moč  $P_N=?$  je na razpolago na antenskem priključku, če znaša pasovna širina antene  $B=100MHz$ ? ( $k_B=1.38 \cdot 10^{-23} J/K$ )

- (A) -115.5dBm (B) -105.6dBm (C) -85.6dBm (D) -75.6dBm

7. Nizkošumni predojačevalnik z ojačanjem  $G=15dB$  doseže šumno število  $F=0.5dB$ . Kolikšno je dovoljeno šumno število sprejemnika  $F_{RX}=?$ , ki sledi predojačevalniku, da šumno število celotne verige ne preseže  $F'=1dB$ ? ( $T_0=290K$ )

- (A) 3.5dB (B) 7.3dB (C) 6.4dB (D) 15.5dB

8. Satelitska sprejemna postaja ima anteno z dobitkom  $G=33dBi$  in šumno temperaturo antene  $T_A=40K$ . Antena je priključena na sprejemnik s šumnim številom  $F=0.8dB$ . Kolikšno je razmerje  $G/T$  opisane sprejemne postaje? ( $T_0=290K$ )

- (A) 53dB/K (B) 49dB/K (C) 43dB/K (D) 59dB/K

9. Neposredni sprejem satelitske TV doma v pasu  $f=12GHz$  je omogočila razpoložljivost nizkošumnih mikrovalovnih tranzistorjev. Kater vrsta polprevodnika omogoča najnižji šum v frekvenčnem področju  $f=12GHz$ ?

- (A) Si (B) InP (C) Ge (D) GaAs

10. Anteno najprej zasukamo v hladno nebo s  $T_1=10K$  in nato v črno telo (iglavci) na tleh na temperaturi  $T_2=290K$ . Razmerje sprejetih moči znaša  $YdB=10\log(P_2/P_1)=7dB$ . Kolikšna je celotna šumna temperatura sistema  $T=T_A+T_S=?$ , ko je antena obrnjena v nebo?

- (A) 10K (B) 70K (C) 150K (D) 280K

11. Rezultat meritve šumne temperature merjenca opleta za  $\Delta T=\pm 30K$  okoli osrednje vrednosti  $T \approx 400K$  zaradi naključne narave merjenih signalov. Kolikšno bo opletanje rezultata  $\Delta T'=?$ , če izračunamo povprečje  $N=36$  zaporednih meritev?

- (A)  $\pm 5K$  (B)  $\pm 11.11K$  (C)  $\pm 0.833K$  (D)  $\pm 30K$

12. Pri merjenju šumnega števila sprejemnika z visokim ojačanjem lahko prekrmilimo v nasičenje določene stopnje v notranjosti sprejemnika zaradi naključne narave merjenih signalov. Rezultat takšne meritve šumnega števila bo:

- (A) premajhen (B) prevelik (C) enak nič (D) pravilen

Priimek in ime:

Elektronski naslov:

1. The common electrode of a power RF transistor is connected to the heat-sink flange. An  $\Omega$ -meter shows a rectifying junction from one of the other two electrodes and a low resistance  $R < 1\Omega$  from the other electrode towards the flange. The transistor is a:
 

(A) NPN common B                      (B) power GaAs FET                      (C) power LDMOS                      (D) NPN common E
2. A high-frequency detector with a low-barrier Schottky diode  $U_{1mA} = 100\text{mV}$  is used to measure a RF power in the range  $P = +30\text{dBm}$ . What is the response of the detector  $U(P)$  where the power  $P$  is in watts [W] and  $\alpha$  is a proportional constant (with units):
 

(A)  $U = \alpha \cdot P$                       (B)  $U = \alpha \cdot P^2$                       (C)  $U = \alpha \cdot \sqrt{P}$                       (D)  $U = \alpha \cdot P^{3/2}$
3. An unknown two-port network is described by the following S-parameter matrix:  $S_{11} = 0$ ,  $S_{12} = j$ ,  $S_{21} = -j$  and  $S_{22} = 0$ . The above network has the following electrical properties (circle the WRONG answer!):
 

(A) uncond.stable                      (B) nonsymmetric                      (C) nonreciprocal                      (D) active
4. A coaxial cable with a polyethylene dielectric  $\epsilon_r = 2.25$  has a characteristic impedance  $Z_k = 50\Omega$ . At which shortest cable length  $l = ?$  the load  $Z = (20 + j0)\Omega$  is transformed into a completely real impedance  $Z' = R' + j0$  at a frequency  $f = 100\text{MHz}$ ? ( $c_0 \approx 3 \cdot 10^8 \text{m/s}$ )
 

(A) 33.3cm                      (B) 25cm                      (C) 75cm                      (D) 50cm
5. A bipolar-transistor amplifier is only conditionally stable because of  $C_{BK} = C_{MILLER} > 0$ . Which countermeasure to achieve unconditional stability does NOT decrease the gain?
 

(A) resistive feedback                      (B) resistive output loading                      (C) neutralization in a symmetric circuit                      (D) common base configuration
6. A large directional antenna is pointed to the Sun to achieve an antenna noise temperature  $T_A = 20000\text{K}$ . What noise power  $P_N = ?$  is available at the antenna connector, if the bandwidth of the antenna amounts to  $B = 100\text{MHz}$ ? ( $k_B = 1.38 \cdot 10^{-23} \text{J/K}$ )
 

(A) -115.6dBm                      (B) -105.6dBm                      (C) -85.6dBm                      (D) -75.6dBm
7. A low-noise preamplifier with a gain of  $G = 15\text{dB}$  achieves a noise figure of  $F = 0.5\text{dB}$ . What is the allowed noise figure  $F_{RX} = ?$  of the following receiver so that the noise figure of the whole chain does not exceed  $F' = 1\text{dB}$ ? ( $T_0 = 290\text{K}$ )
 

(A) 3.5dB                      (B) 7.3dB                      (C) 6.4dB                      (D) 15.5dB
8. A satellite receiving station includes an antenna with a gain of  $G = 33\text{dBi}$  and antenna noise temperature of  $T_A = 40\text{K}$ . The antenna is connected to a receiver with a noise figure of  $F = 0.8\text{dB}$ . What is the  $G/T = ?$  figure of merit of this station? ( $T_0 = 290\text{K}$ )
 

(A) 53dB/K                      (B) 49dB/K                      (C) 43dB/K                      (D) 59dB/K
9. Direct-to-home satellite TV in the  $f = 12\text{GHz}$  band was made possible by the availability of low-noise transistors. What kind of semiconductor allows the lowest noise performance in the  $f = 12\text{GHz}$  frequency range?
 

(A) Si                      (B) InP                      (C) Ge                      (D) GaAs
10. An antenna is first pointed in the cold sky with  $T_1 = 10\text{K}$  and later into a ground black-body target (pine trees) at  $T_2 = 290\text{K}$ . The power ratio is  $Y_{dB} = 10 \log(P_2/P_1) = 7\text{dB}$ . What is the total system noise temperature  $T = T_A + T_S = ?$  while pointed in the sky?
 

(A) 10K                      (B) 70K                      (C) 150K                      (D) 280K
11. The result of a noise temperature measurement deviates by  $\Delta T = \pm 30\text{K}$  around a center value of  $T \approx 400\text{K}$  due to the random nature of the measured signals. What is the expected deviation  $\Delta T' = ?$  if an average of  $N = 36$  successive measurements is used?
 

(A)  $\pm 5\text{K}$                       (B)  $\pm 11.11\text{K}$                       (C)  $\pm 0.833\text{K}$                       (D)  $\pm 30\text{K}$
12. While measuring the noise figure of a high-gain receiver, some amplifier stages of the latter may be driven into saturation due to the random nature of the measured signals. In this case the obtained noise figure will result:
 

(A) too small                      (B) too large                      (C) equal to zero                      (D) correct

Name:

Email: