Assignment VIII (Millimeter-wave system)

- *Tick the most appropriate answer.*
- *All symbols have their usual meaning.*

1. The noise that affects performance of a channel most is
   a. thermal noise b. shot noise   c. flicker noise d. plasma noise.
   Ans: a. thermal noise

2. Typical noise power of a two port device over a bandwidth of 100 MHz centered at 77 GHz ranges from
   a. −120 dBm to −160 dBm   b. −80 dBm to −120 dBm
   c. −20dBm to −60 dBm   d. 0 dBm to -40 dBm
   Ans: b. −80 dBm to −120 dBm

3. Tick the wrong statement. The dynamic range of a millimeter wave active component depends on
   a. noise floor   b. saturation range
   c. 3rd order intercept   d. none of the above.
   Ans: d. none of the above.

4. The flicker noise is likely to affect which part of the frequency spectrum?
   a) It is uniform throughout the spectrum
   b) It is high at high frequency
   c) It is high at low frequency
   d) It is high at mid band frequency
   Ans: (c) It is high at low frequency

5. Under which conditions the Rayleigh–Jeans approximation tends to fail
   a. As bandwidth →∞, noise power →∞. b. As bandwidth →0, noise power →∞.
   c. As bandwidth →∞, noise power →0. d. As bandwidth →0, noise power →0.
   Ans: a. As bandwidth →∞, noise power →∞.

6. An amplifier with a gain of 12 dB, a bandwidth of 150 MHz, and a noise figure of 4 dB feeds a receiver with equivalent noise temperature of 900 K. The noise figure of the overall system is
   a. 0 dB   b. 3dB   c. 4dB   d. 4.3dB
   Ans: (d) 4.3dB

7. The front end of a millimeter wave receiver is formed by cascading a LNA (G_a = 10 dB, NF = 2 dB), a bandpass filter (insertion loss = 1 dB), and a mixer (conversion loss = 3 dB, NF = 4 dB). Then overall noise figure of the front end is
   a) 1dB   b) 2dB   c) 2.55dB   d) 5.22dB
   Ans: (c) 2.55 dB

8. The front end of a millimeter wave receiver is formed by cascading a LNA (G_a = 10 dB, NF = 2 dB), a bandpass filter (insertion loss = 1 dB), and a mixer (conversion loss = 3 dB, NF = 4 dB). Then overall system gain is

a) 5.93   b) 3.95   c) 3.95dB d) 5.93dB

Ans: (c) 3.95 dB

9. Considering source noise as zero, calculate the total noise power over a bandwidth of 100 MHz generated by an amplifier with equivalent noise temperature of 510 K, power gain of 20 dB and mid-band frequency of 60 GHz.

a) -71.5 dBm b) -82.2 dBm c) -101.5 dBm d) none of the above.

Ans: (a) -71.5 dBm

10. An antenna has antenna efficiency of 90% and is at a physical temperature of 300 K. Then the equivalent noise temperature of the antenna is

a) 33.3 K   b) 59 K   c) 270 K   d. 333.3 K

Ans: a) 33.3 K

11. An amplifier is connected to a source which is an equivalent noise temperature of 300 K. If the equivalent noise temperature of the amplifier is 450 K and available power gain = 20 dB, then the operating noise figure of the amplifier is

a) 23.98 dB   b) 26.5 dB c) 3.98 dB   d) 2.39 dB

Ans: c) 3.98 dB

12. Among the given components of a receiver, the most noisy component is

a) LNA b) bandpass filter c) mixer   d) IF amplifier

Ans: c) mixer

13. What is the value of emissivity for a perfect Black body?

a) 0   b) 1   c) 3   d. infinity

Ans: (b) 1

14. Reflectivity of ocean is given as 0.6 and is at a temperature of $37^\circ C$. Then its equivalent noise temperature is

a) 186 K   b) 174 K   c) 124 K   d. 116 K

Ans: c) 124 K

15. A material that closely resembles Black Body is

a) bare metal b) dry asphalt c) dry concrete   d) hard packed dirt

Ans: (d) hard packed dirt

16. The following outdoor imaging system can operate under severe weather conditions like dense fog, sand storm, snow fall etc.

a) visible light imaging b) X-ray imaging   c) Infrared imaging d) millimeter-wave imaging.

Ans: d) millimeter-wave imaging.

17. Super heterodyne receiver although being a very popular architecture, is not usually preferred for hand held devices because

a) it requires bulky power amplifiers

b) it requires bulky LNAs

c) it requires many components in general and consumes high dc power

d) it is relatively an old technology

Ans: c) it requires many components in general and consumes high dc power

18. The receiver that does not use any mixer is
    a) super heterodyne architecture
    b) homodyne architecture
    c) six port architecture
    d) heterodyne architecture.
    Ans: c) six port architecture

19. The effect that possesses maximum problem for a homodyne receiver is
    a) LO leakage to antenna port   b) RF leakage to LO port
    c) Poor antenna efficiency   d) Small gain of the amplifier stage.
    Ans: a) LO leakage to antenna port

20. A six port receiver is popular at millimeter wave frequency because of its
    a) accuracy   b) higher SNR,
    c) many passive components   d) all of these.
    Ans: d) all of these