ECE 321 – PRINCIPLES OF COMMUNICATION

MEASUREMENTS IN DECIBELS – TEST YOUR KNOWLEDGE

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1. **Decibels (dB) represent .....**

   a) Absolute power values

   b) Logarithmic ratios

   c) Linear voltage scales

   Answer: b) Logarithmic ratios

   Explanation: dB quantifies ratios (e.g., gain/loss) on a logarithmic scale.

2. **The dB formula for power gain G in terms of power P is: ------**

   a) $G_{dB} = 20log_{10}\left(\frac{P_2}{P_1}\right)$

   b) $G_{dB} = 10log_{10}\left(\frac{P_2}{P_1}\right)$

   c) $G_{dB} == log_e\left(\frac{P_2}{P_1}\right)$

   Answer: b) $G_{dB} = 10log_{10}\left(\frac{P_2}{P_1}\right)$

   Explanation: Power ratios use 10 due to $P \propto V^2$

3. **A power ratio of 1 corresponds to .....**

   a) 0 dB

   b) 3 dB

   c) 10 dB

   Answer: a) 0 dB

   Explanation: $10log_{10}(1)=0$ dB (no gain/loss).

4. **A 3 dB power gain implies a linear power ratio of .....**

   a) 1.5

   b) 2

c) 3

Answer: b) 2

Explanation: $10\log_{10}(x)=3 \Rightarrow \log_{10}(x)=0.3 \Rightarrow x=10^{0.3} \approx 2$

5. **For voltage gain, the dB formula assumes .....**

   a) Identical resistance

   b) Identical current

   c) Any impedance

   Answer: a) Identical resistance

   Explanation: $V_{dB}=20\log_{10}\left(\frac{V_2}{V_1}\right)$ *holds only if R1=R2*

PART 2: CONVERSIONS

6. **Convert 20 dB to a linear power ratio.**

   Answer: 100

   Explanation: $10\log_{10}(x) = 20 \Rightarrow \log_{10}(x) = 2 \Rightarrow x = 10^2 = 100.$

7. **Convert a voltage ratio of 100 to dB.**

   Answer: 40 dB

   Explanation: $20\log_{10}(100) = 20 \times 2 = 40$ *dB.*

8. **A loss of -6 dB corresponds to a power ratio of .....**

   a) 0.25

   b) 0.5

   c) 0.75

   Answer: a) 0.25.

   Explanation: $10\log_{10}(x) = -6 \Rightarrow x = 10^{-0.6} \approx 0.25.$

9. **A system has a gain of 20 dB. If input power is 2 mW, output power is:**

   a) 20 mW

   b) 200 mW

   c) 2 W

   Answer: b) 200 mW

Explanation: $P_{\text{out}} = P_{\text{in}} \times 10^{20/10} = 2 \times 100 = 200$ *mW.*

10. **A voltage gain of 40 dB corresponds to a linear ratio of:**

    Answer: 100

    Explanation: $20 \log_{10}(x) = 40 \Rightarrow \log_{10}(x) = 2 \Rightarrow x = 100.$

11. **Convert 0.001 W to dBm.**

    Answer: 0 dBm

    Explanation: $P_{\text{dBm}} = 10 \log_{10}\left(\frac{0.001}{0.001}\right) = 10 \log_{10}(1) = 0$ *dBm.*

12. **-30 dB implies a power reduction by a factor of .....**

    a) 100

    b) 1000

    c) 10,000

    Answer: b) 1000

    Explanation: $10 \log_{10}(x) = -30 \Rightarrow x = 10^{-3} = 0.001$ *(factor =* $\frac{1}{0.001} = 1000$*).*

13. **A 10:1 voltage divider has a gain of .....**

    a) -20 dB

    b) -10 dB

    c) -6 dB

    Answer: a) -20 dB

    Explanation: $20 \log_{10}(0.1) = -20$ *dB.*

14. **A 3 dB bandwidth is the frequency range where power is .....**

    a) Half of maximum

    b) 70.7% of maximum

    c) Unchanged

    Answer: a) Half of maximum

    Explanation: -3 dB power ≈ 50% of max power

15. **An amplifier has 30 dB voltage gain. If V_{in}=0.1 V, V_{out}=?**

Answer: 10 V

Explanation: $V_{\text{out}} = V_{\text{in}} \times 10^{30/20} = 0.1 \times 10^{1.5} \approx 10\ V.$

PART 3: REFERENCE UNITS (DBM, DBW)

16. **0 dBm equals:**

    a) 0 W

    b) 1 mW

    c) 1 W

    Answer: b) 1 mW

    Explanation: dBm references 1 mW (0 dBm = 1 mW).

17. **Convert 20 dBm to mW.**

    Answer: 100 mW

    Explanation: $P = 1 \times 10^{20/10} = 100\ mW.$

18. **30 dBW is equivalent to .....**

    a) 0 dBm

    b) 30 dBm

    c) 60 dBm

    Answer: c) 60 dBm

    Explanation: 30 dBW = 1000 W; dBm = $10 \log_{10}(1000/0.001) = 60$ dBm.

19. **A signal is -10 dBm. Its power is**

    a) 0.1 mW

    b) 0.01 mW

    c) 0.001 mW

    Answer: a) 0.1 mW.

    Explanation: $P = 1 \times 10^{-10/10} = 10^{-1} = 0.1\ mW.$

20. **10 W expressed in dBm is .....**

    Answer: 40 dBm

Explanation: $P_{\text{dBm}} = 10 \log_{10}\left(\frac{10}{0.001}\right) = 10 \log_{10}(10,000) = 40\ dBm.$

PART 4: CASCADED SYSTEMS

21. **Three amplifiers have gains of 10 dB, 15 dB, and -5 dB. Total gain is .....**

    a) 20 dB

    b) 25 dB

    c) 30 dB

    Answer: a) 20 dB

    Explanation: Total dB = $10 + 15 - 5 = 20$ *dB.*

22. **A filter (-3 dB) is followed by an amplifier (+20 dB). Net gain is .....**

    a) 17 dB

    b) 23 dB

    c) 60 dB

    Answer: a) 17 dB

    Explanation: $-3 + 20 = 17$ *dB.*

23. **Stage 1: -6 dB, Stage 2: +12 dB. If input is 4 W, output is .....**

    Answer: 16 W

    Explanation: Net gain = $-6 + 12 = 6$ *dB.* $P_{\text{out}} = 4 \times 10^{6/10} = 4 \times 4 = 16$ *W.*

24. **A 20 dB attenuator followed by a 30 dB amplifier has net gain .....**

    a) 10 dB

    b) 50 dB

    c) -10 dB

    Explanation: $-20 + 30 = 10$ *dB.*

25. **Two amplifiers (10 dB each) and a cable (-2 dB). Overall gain .....**

    Answer: 18 dB

    Explanation: $10 + 10 - 2 = 18$ *dB.*

PART 5: SNR AND NOISE

26. **SNR is 20 dB. If signal power is 100 mW, noise power is .....**

a) 1 mW

b) 10 mW

c) 100 mW

Answer: a) 1 mW

Explanation: $\mathrm{SNR}_{\mathrm{dB}} = 10\log_{10}\left(\frac{P_s}{P_n}\right) = 20 \Rightarrow \frac{P_s}{P_n} = 100 \Rightarrow P_n = \frac{100\ \mathrm{mW}}{100} = 1\ mW.$

27. **If the noise floor is -90 dBm, the minimum detectable signal (0 dB SNR) must be .....**

a) -90 dBm

b) -60 dBm

c) 0 dBm

Answer: a) -90 dBm

Explanation: SNR = 0 dB $\Longrightarrow$ $P_{\mathrm{signal}} = P_{\mathrm{noise}} = -90$ dBm.

28. **After a 3 dB noise figure amplifier, SNR .....**

a) Halves

b) Doubles

c) Unchanged

Answer: a) Halves

Explanation: Noise figure (NF) = 3 dB $\Longrightarrow$ SNR drops by 3 dB (factor of 2)

29. **Input SNR = 30 dB. Amplifier NF = 6 dB. Output SNR is .....**

a) 24 dB

b) 30 dB

c) 36 dB

Answer: a) 24 dB

Explanation: Output SNR = Input SNR - NF = 30 - 6 = 24 dB.

30. **A system has noise power 10^{-12} W. Express noise power in dBm.**

Answer: -90 dBm

Explanation: $P_{\text{dBm}} = 10 \log_{10} \left(\frac{10^{-12}}{0.001} \right) = 10 \log_{10}(10^{-9}) = -90$ *dBm.*