Assignment III (Guiding Structure II)

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

1. Transverse resonance appears in a microstrip line when its width is approximately
   a. \( \lambda_g/4 \), b. \( \lambda_g/2 \), c. \( \lambda_g \), d. does not depend on \( \lambda_g \)
   Ans: (b) \( \lambda_g/2 \)

2. The optimal thickness of metal that might be used for any PCB is
   a. 0.25\( \times \)skin depth, b. 0.5\( \times \)skin depth, c. 1\( \times \)skin depth, d. 5\( \times \)skin depth.
   Ans: d. 5\( \times \)skin depth

3. For any PCB based millimeter-wave circuits, power lost to surface wave modes
   a. decreases with frequency, b. depends on type of guiding structures, c. does not depend on frequency, d. depends on loss tangent of the dielectric material.
   Ans: b. depends on type of guiding structures

4. In microstrip coupled line, effective dielectric constant in i) even mode is \( \varepsilon_{re,even} \) and ii) in odd mode is \( \varepsilon_{re,odd} \), then which is the correct relationship?
   a. I = II, b. I > II, c. I < II, d. cannot be determined.
   Ans: (b) I > II.

5. Threshold frequency of coupling to TM\(_0\) surface wave mode is:
   a. \( \frac{c}{2\pi d} \sqrt{\frac{2}{\varepsilon_r - 1} \tan^{-1} \varepsilon_r} \), b. \( \frac{c}{4d} \sqrt{\varepsilon_r - 1} \), c. \( \frac{c}{\sqrt{\varepsilon_r (2W + d)}} \), d. \( \frac{c}{4\pi d} \sqrt{\frac{2}{\varepsilon_r - 1} \tan^{-1} \varepsilon_r} \)
   Ans: (a) \( \frac{c}{2\pi d} \sqrt{\frac{2}{\varepsilon_r - 1} \tan^{-1} \varepsilon_r} \)

6. The mode that provides minimum conductor loss for NRD guide is
   a. LSE\(_{11}\), b. LSM\(_{11}\), c. TE\(_{11}\), d. TM\(_{11}\).
   Ans: (a) LSE\(_{11}\).

7. For NRD guide, which mode has the lowest cutoff frequency?
   a. LSE\(_{11}\), b. LSM\(_{11}\), c. LSE\(_{21}\), d. LSM\(_{21}\)
   Ans: (a) LSE\(_{11}\).

8. Which mode in the NRD guide is/are non-radiative?
   a. LSE\(_{11}\), b. LSM\(_{11}\), c. LSE\(_{21}\), d. All of these
   Ans: (d) All of these.

9. Assuming the guiding structures are fabricated in the same PCB, tick the correct statement.
   a. Substrate integrated waveguide may provide lower loss than a microstrip line.
   b. The power handling capability of CPW line is more than that for a Substrate integrated waveguide.
   c. For a Substrate integrated waveguide, total loss increases with frequency.
   d. None of the above.
10. Which guide suffers more conductor loss at millimeter-wave frequencies? 
   a. image guide, b. insular image guide, c. Trapped image guide, d. NRD guide. 
   Ans: (a) image guide.

11. If $\varepsilon_r$ increases for an image guide, electric field confinement in the dielectric region 
   a. increases, b. decreases, c. remains constant, d. does not depend on $\varepsilon_r$. 
   Ans: (a) increases.

12. If $2a$ is the width and $b$ is the height of the dielectric channel of an image guide, then mono 
   mode bandwidth is maximum when 
   a. $2a = b$, b. $a = b$, c. $a = 2b$, d. $\sqrt{a} = \sqrt{b}$. 
   Ans: b. $a = b$

13. If $\varepsilon_r$ decreases for an image guide, cutoff frequency for $E_{ii}$ mode will— 
   a. increase, b. decrease, c. remain constant, d. does not depend on $\varepsilon_r$. 
   Ans: (b) decreases.

14. Arrange according to losses of the guides—i. Air filled rectangular waveguide, ii. microstrip 
   line, iii. Substrate integrated waveguide (SIW), 
   a. i>i>iii, b. ii>i>iii, c. ii>i>iii, d. ii>iii>i. 
   Ans: (d) ii>iii>i.

15. For a properly designed substrate integrated waveguide (SIW) at millimeter-wave 
   frequencies, the loss component that is highest 
   a. radiation loss, b. leakage loss, c. dielectric loss, d. conductor loss. 
   Ans: (d) conductor loss.

16. At a given frequency, loss increases for a SIW when 
   a. via separation increases, b. thickness is reduced, c. $\varepsilon_r$ of the dielectric channel decreases, d. 
   first two. 
   Ans: d. first two.

17. The relationship between average power handling capability ($P_{avg}$) of SIW, its height ($h$) and 
   $\varepsilon_r$ of the dielectric channel is 
   a. $P_{avg} \propto h$, b. $P_{avg} \propto 1/h$, c. $P_{avg} \propto \varepsilon_r$, d. none of these. 
   Ans: (a) $P_{avg} \propto h$.

18. The peak power handling capability ($P_{peak}$) of SIW with increasing frequency 
   a. increases, b. decreases, c. remains constant, d. first increases and then decreases. 
   Ans: (b) decreases.

19. Ionization breakdown occurs in the following guiding structures 
   a. microstrip line, b. image guide, c. SIW, d. air filled waveguide. 
   Ans: d. air filled waveguide.

20. Choose the correct statement. 
   a. In comparison to ionization breakdown, Multipaction is more localized effect. 
   b. Probability of ionization breakdown increases if vacuum is used in a guiding structure. 
   c. Multipaction is due to resonant growth of free electron between two surfaces.
d. Dielectric breakdown is due to resonant growth of free electron between two surfaces.
Ans: c. Multipaction is due to resonant growth of free electron between two surfaces.