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全部單選題。

1. (5%) $\nabla\cdot(\mathbf{a}_x+\mathbf{a}_y+\mathbf{a}_z)$ is equal to
   (A) 1 (B) $\mathbf{a}_x+\mathbf{a}_y+\mathbf{a}_z$ (C) 0 (D) 3

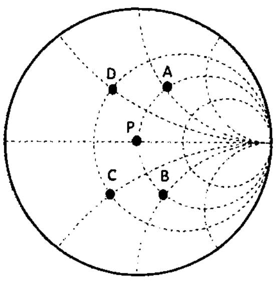
2. (5%) $\nabla\times(\mathbf{a}_x+\mathbf{a}_y+\mathbf{a}_z)$ is equal to
   (A) 1 (B) $\mathbf{a}_x+\mathbf{a}_y+\mathbf{a}_z$ (C) 0 (D) 3

3. (5%) With characteristic impedance Z_0 = 100 Ω, what is the reflection coefficient when the loading impedance Z_L is 50 Ω?
   (A) 0 (B) $\frac{1}{2}$ (C) $\frac{-1}{2}$ (D) $\frac{-1}{3}$

4. (5%) For a 50 Ω loading to be transformed into 100 Ω using quarter-wave transmission line, the characteristic impedance of this transmission line should be
   (A) 50 Ω (B) 100 Ω (C) $50\sqrt{2}$ Ω (D) 5000 Ω

5. (5%) When a half-wavelength transmission line is loaded with Z_L=0, its input reflection coefficient will be
   (A) −1 (B) 0 (C) 1 (D) $\frac{1+j}{\sqrt{2}}$

6. (5%) Which of the following points will be the most likely answer for a normalized impedance of $\frac{1+j}{2}$
   (A) Point A (B) Point B (C) Point C (D) Point D



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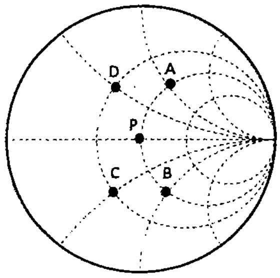
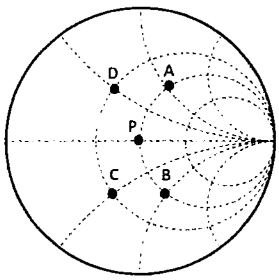
7. (5%) A loading impedance Z_L has its reflection coefficient indicated as point P on the Smith chart. When a capacitor is in series with this Z_L, which of the following points will be most likely position for the new reflection coefficient?

(A) Point A　(B) Point B　(C) Point C　(D) Point D



8. (5%) In order to move impedance Z_A (as Point A) to Z_C (as Point C) with a transmission line, what is the most likely length for this line? Here λ is the wave length.

(A) λ　(B) $\frac{\lambda}{2}$ (C) $\frac{\lambda}{4}$　(D) $\frac{\lambda}{8}$



9. (3%) A hollow rectangular waveguide cannot propagate TEM waves because:

(A) of the losses caused　(B) of the existence of only one conductor　(C) it is dependent on the type of the material used　(D) none of the mentioned

10. (3%) In TE mode of wave propagation in a rectangular waveguide, what is the equation that has to be satisfied?

(A) $(\partial^2/\partial x^2 + \partial^2/\partial y^2 - k_c^2).H_z(x, y) = 0$　(B) $(\partial^2/\partial x^2 - \partial^2/\partial y^2 + k_c^2).H_z(x, y) = 0$

(C) $(\partial^2/\partial x^2 + \partial^2/\partial y^2 + k_c^2).H_z(x, y) = 0$　(D) None of the mentioned

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11. (3%) For TE_{10} mode, if the waveguide is filled with air and the broader dimension of the waveguide is 2 cm, then the cutoff frequency is:

(A) 5 MHz (B) 7.5 MHz (C) 7.5 GHz (D) 5 GHz

12. (3%) For dominant mode propagation in TE mode, if the rectangular waveguide has a broader dimension of 31.41 mm, then the cutoff wave number is:

(A) 500 (B) 50 (C) 1000 (D) 100

13. (3%) The wavelength of a wave in a waveguide

(A) depends only on the waveguide dimensions and the free-space wavelength

(B) is greater than of free space (C) is inversely proportional to the phase velocity

(D) is directly proportional to the group velocity

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14. (5%) As shown in Fig. 1, a dielectric-slab waveguide with permittivity $\epsilon_d = 5\epsilon_0$ and permeability $\mu_d = \mu_0$ is situated in free space (ϵ_0, μ_0). Assume that there is no dependence on the *x*-coordinate, the dielectric is lossless, and the waves propagate in the +*z*-direction. f_{c1} and f_{c2} are the cutoff frequency of the lowest-order odd TM mode when the dielectric thickness is *d*= 3 mm and *d*= 6 mm, respectively. Determine (f_{c1}, f_{c2}). (A) (0 Hz, 0 Hz) (B) (5 GHz, 10 GHz) (C) (10 GHz, 20 GHz) (D) (20 GHz, 40 GHz)

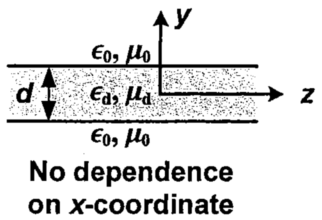

Fig. 1

15. (5%) As shown in Fig. 1, a dielectric-slab waveguide with permittivity $\epsilon_d = 5\epsilon_0$ and permeability $\mu_d = \mu_0$ is situated in free space (ϵ_0, μ_0). Assume that there is no dependence on the *x*-coordinate, the dielectric is lossless, and the waves propagate in the +*z*-direction. The waveguide can support odd TM modes designated as $TM_{O,n}$, even TM modes as $TM_{E,n}$, odd TE modes as $TE_{O,n}$, and even TE modes as $TE_{E,n}$ where n=1,2,3,.... Determine which mode whose field characteristics will not be disturbed when a perfectly conducting plane is introduced to coincide with the *y*= 0 plane.

(A) $TE_{E,1}$ (B) $TM_{O,1}$ (C) $TM_{E,1}$ (D) $TM_{E,2}$

16. (5%) As shown in Fig. 1, a dielectric-slab waveguide with permittivity $\epsilon_d = 5\epsilon_0$ and permeability $\mu_d = \mu_0$ is situated in free space (ϵ_0, μ_0). Assume that there is no dependence on the *x*-coordinate, the dielectric is lossless, and the waves propagate in the +*z*-direction. Determine the maximum thickness of the slab material that will allow single TE and TM mode operation below 20 GHz.

(A) 3 mm (B) 3.25 mm (C) 3.5 mm (D) 3.75 mm

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17. (5%) Consider oblique incidence with parallel polarization from medium 1 to medium 2, the Brewster angle is

(A) $\sin^{-1}\frac{1-\frac{\mu_1\epsilon_2}{\mu_2\epsilon_1}}{1-(\frac{\mu_1}{\mu_2})^2}$, (B) $\sin^{-1}\sqrt{\frac{1-\frac{\mu_1\epsilon_2}{\mu_2\epsilon_1}}{1-(\frac{\mu_1}{\mu_2})^2}}$, (C) $\tan^{-1}\sqrt{\frac{\epsilon_2}{\epsilon_1}}$, (D) no exist.

18. (5%) The four Maxwell's equations do not contain
(A) Faraday's law, (B) Coulomb's law, (C) Ampere's law, (D) Gauss's law.

19. (5%) A sinusoidal electric intensity of amplitude 250 V/m and frequency 1 GHz exists in a lossy dielectric medium that has a relative permittivity of 2.5 and a loss tangent of 0.001. The average power dissipated per unit volume is
(A) 2.14, (B) 4.34, (C) 68.24, (D) 74.32 W/m^3.

20. (5%) The phase constant in a low-loss dielectric medium is

(A) $\omega\sqrt{\mu\epsilon}$, (B) $\frac{\omega\epsilon"}{2}\sqrt{\frac{\mu}{\epsilon'}}$, (C) $\omega\sqrt{\mu\epsilon'}\left[1+\frac{1}{8}\left(\frac{\epsilon"}{\epsilon'}\right)^2\right]$, (D) $\sqrt{\pi f\mu\sigma}$.

21. (5%) A plane wave with a phase velocity $u_p = \omega/\beta$ propagates in a medium. The anomalous dispersion occurs with

(A) $\frac{du_p}{d\omega} > 0$, (B) $\frac{du_p}{d\omega} < 0$, (C) $\frac{du_p}{d\omega} = 0$, (D) $u_p = 1/\sqrt{\mu\epsilon}$.

22. (5%) The induction cooker provides fast heating with
(A) flux cutting emf, (B) traveling wave, (C) retarded potential, (D) eddy current.