第一大題單選題，請將答案寫在電腦閱卷答案卡上

1. (2%) Which of the following statement is NOT true?
   (a) The signal on a transmission line will result in time delay.
   (b) The key difference between the lumped circuit and the distributed circuit is the electrical size.
   (c) A transmission line can be only observed at microwave frequency or above.
   (d) In most of the cases, a transmission line provides an efficient way for point-to-point power transferring.
2. (2%) Which of the following statement is NOT true?
   (a) The propagation of a TEM line is very similar to that of a uniform plane wave.
   (b) The TEM wave has no field component in the direction of propagation.
   (c) The Coaxial line can support a pure TEM mode.
   (d) The Microstrip line can support a pure TEM mode.
3. (2%) Regarding the lumped circuit mode of an infinitesimal section of transmission line, which of the following statement is NOT true?
   (a) The per-unit-length resistance accounts for the dielectric loss.
   (b) The per-unit-length capacitance accounts for the electric field between the lines.
   (c) The circuit model cannot be uniquely defined.
   (d) The per-unit-length inductance for the magnetic field due to current flow.
4. (2%) Which one of the following statement about "characteristic impedance" is NOT true?
   (a) It can't be measured using a multimeter.
   (b) It is the square root of the ratio of unit length capacitance over unit length inductance.
   (c) It is the ratio of the electrical field intensity over magnetic field intensity in a transmission line.
   (d) It can be adjusted by changing the transmission line geometry.
5. (2%) A reflector antenna for radar applications has a -40-dB input reflection coefficient. Assuming an input power of 1 MWs (mega watts) is delivered to antenna, what is the reflected power?
   (a) 0 W, (b) 40 W, (c) 100W, (d) 10000W

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6. (2%) The sources of crosstalk noise can be divided into electric coupling and magnetic coupling. Which of the following statement is NOT true?
   (a) Electric coupling can be modeled by mutual capacitance.
   (b) Magnetic coupling can be modeled by mutual inductance.
   (c) The electric coupling at near end and that at far end have the same polarity.
   (d) The magnetic coupling at near end and that at far end have the same polarity.
7. (2%) If the transmission line is infinitely long, the response at A will keep exactly the same if the transmission line is modeled as?
   (a) A capacitor
   (b) A short circuit
   (c) A resistor of $R = Z_0$
   (d) An inductor
8. (2%) The reflection coefficient at observed on a 50Ω line is -1/3. Which one of the following statement is WRONG?
   (a) The line impedance is 25Ω.
   (b) The normalized line impedance is 0.5.
   (c) The normalized line admittance is 2.
   (d) The line admittance is 100 Siemens.
9. (2%) Please determine the number of guided modes, while the $\epsilon = 3\epsilon_0$ for dielectric slab waveguide and surrounded by air.
   (a) 0, (b) 1, (c) 3, (d) ∞
10. (2%) The rectangular waveguide have side a and b, and it filled with dielectric media (ϵ, μ), what is the cutoff frequency of the propagating mode.

(a) $f_c = \frac{1}{\sqrt{\mu\epsilon}}\sqrt{(\frac{m}{a})^2 + (\frac{n}{b})^2}$

(b) $f_c = \frac{1}{2\sqrt{\mu\epsilon}}\sqrt{(\frac{m\pi}{a})^2 + (\frac{n\pi}{b})^2}$

(c) $f_c = \frac{1}{2\sqrt{\mu\epsilon}}\sqrt{(\frac{m}{a})^2 + (\frac{n}{b})^2}$

(d) $f_c = \frac{1}{2\sqrt{\mu\epsilon}}\sqrt{(\frac{m}{a}) + (\frac{n}{b})}$

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11. (2%) What is the minimum input resistance seen at the input of a 50Ω line having a length of at least one half wavelength and a VSWR of 5?
    (a) 2Ω
    (b) 10Ω
    (c) 50Ω
    (d) 250Ω
12. (2%) A lossless quarter-wavelength transformer is designed to match a resistive load to a lossless transmission line at 1.0GHz. Which one of the following statement is true?
    (a) The impedance is also matched at 0.5 GHz
    (b) The impedance is also matched at 2.0 GHz
    (c) The impedance is also matched at 3.0 GHz
    (d) The impedance can only be matched at 1.0 GHz
13. (2%) What is the wavelength of a 1GHz signal?
    (a) 0.3m, (b) 300m, (c) 300nm, (d) 3×10^8m
14. (2%) Computation of the parameter C can be based on the solution of boundary value problems. The governing partial differential equation for the capacitance computation is usually called
    (a) Laplace's Eq., (b) Helmholtz's Eq., (c) Poisson's Eq., (d) Boltzman Eq.
15. (2%) Which one of the following item provides least reflection in the optical range?
    (a) a piece of white paper, (b) a piece of black paper, (c) a mirror,
    (d) a piece of glass
16. (4%) For a parallel-plate waveguide of spacing a=1cm and filled with a dielectric media $\mu = \mu_0$ *and* $\epsilon = 9\epsilon_0$, find the guide characteristic impedance of TM_{10} wave at frequency f=10GHz.
    (a) 100Ω, (b) 108.8Ω, (c) 54.8Ω, (d) 77.2Ω
17. (4%) A waveguide filled with a material whose $\epsilon = 9\epsilon_0$ has dimensions of a=2cm and b=1.4cm. If the waveguide is to transmit 3-GHz signals, what possible modes can be used for the transmission?
    (a) TE_{10}, (b) TE_{01}, (c) TEM, (d) TM_{11}
18. (4%) Assuming the transmission line is terminated with a resistor, the measured SWR is 4 and the line characteristic impedance is 50ohm, find the load resistance?
    (a) 12.5Ω, (b) 50Ω, (c) 125Ω, (d) 200Ω,

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19. (4%) The characteristic impedance of a distortionless transmission line is 50 ohm. If the per-unit-length shunt capacitance is 200pF/m, which one will be the closest material of this transmission line used?
(a) Silicon Dioxide ($\epsilon_r = 4$)
(b) Aluminum nitride ($\epsilon_r = 9$)
(c) Polystyrene ($\epsilon_r = 2$)
(d) Diamond ($\epsilon_r = 16$)

20. (4%) Two quarter-wavelength transmission lines are connected in cascaded. The first section has a characteristic impedance $2Z_0$ while the second one has a characteristic impedance Z_0. If the load impedance at the end of the second section is Z_L. Please express the input impedance of two quarter-wavelength transmission lines in terms of Z_L.
(a) Z_L, (b) $2Z_L$, (c) $4Z_L$, (d) $8Z_L$

第二大題計算題，請將過程與答案寫在答案卷上

21. (30%) In Fig. 1, media 1 and 3 extend to infinity, and medium 2 is a dispersive (i.e., the material parameters depend on frequency) slab. For an infinite planar sheet current, lying in z=0 plane, $\vec{J}_s(t) = -2J_{s0}\cos^2(1.5\times10^8\pi t)\hat{a}_x$ A/m,
there will be electric and magnetic fields in the three media. The dispersion relations of medium 2 are listed in the following Table 1:

	$\varepsilon(\omega)$	$\mu(\omega)$
$\omega = 0$	$2\varepsilon_0$	$2\mu_0$
$\omega = 1.5\times10^8\pi$	$2.5\varepsilon_0$	$2.5\mu_0$
$\omega = 3\times10^8\pi$	$3\varepsilon_0$	$3\mu_0$

(1) Please find the time-dependent form electric- and magnetic fields in all three media. (12%)
(2) Please find the time-average Poynting vectors in media 1 and 2 and explain the physical reason of the results briefly. (8%)
(3) By adding another infinite planar sheet current $\vec{J}_{s2}(t)$ at z=0, you can get a circular polarized wave propagating toward -z. Please write down the addition current sheet $\vec{J}_{s2}(t)$ at z=0 and explain the sense of rotation of circular polarization. (10%)

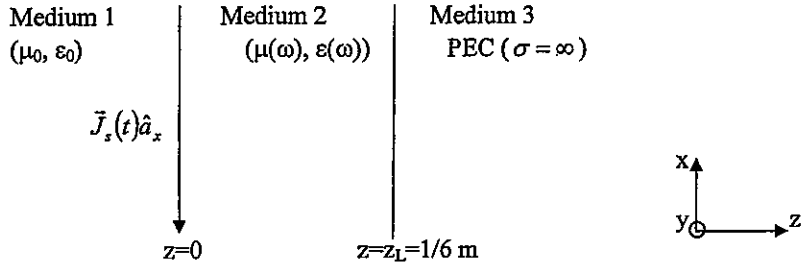

Fig. 1 for Problem 21

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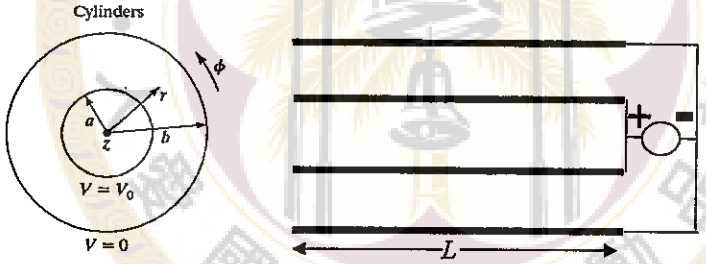
22. (20%) In Fig. 2, a cylindrical capacitor consists of an inner conductor of radius a and an outer conductor of radius b. The space between the conductors is perfect dielectric with (μ_0, ε) and the length of the capacitor is L. Fringe effect can be neglected for $L >> a,b$.

(1) By applying a DC voltage V_0, there will be a charge $+Q$ on the inner cylinder and $-Q$ on the outer cylinder, please derive the relation between V_0 and Q. (6%)

(2) Following (1), please calculate the capacitance by using $C = Q/V$. (4%)

(3) By applying an AC voltage $V_0(t) = \sin(2\pi \cdot 10^6 t)\sin(4\pi \cdot 10^6 t)$, there will be a charge $+Q(t)$ on the inner cylinder and $-Q(t)$ on the outer cylinder. Assume the relation between V_0 and Q is the same as that in (1). Please calculate the capacitance by using $I = \frac{dQ}{dt} = C\frac{dV}{dt}$ and show that the result is the same as that in (2). Also please explain what's questionable about the assumption about the relation between V_0 and Q and under what condition it can be applied? (6%)

(4) Following (3), please calculate the root-mean-square value of current drawn from the voltage source. (4%)



Top View　　Side View

Fig. 2 for Problem 22

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