

國立臺北大學 106 學年度學士班暨進修學士班轉學生招生考試試題

系別：電機工程學系 2 年級(學士班)

考試時間：80 分鐘

科目：普通物理

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可 不可使用計算機

1. Please briefly describe the follow laws/effect/principle:

- (A) Lorentz Force Law (5%)
- (B) Einstein's Photoelectric Effect (5%)
- (C) Heisenberg's Uncertainty Principle (5%)
- (D) Lenz's Law (5%)

2. A sinusoidal electromagnetic wave of frequency 30.0 MHz travels in free space in the x direction.

- (A) Determine the wavelength of the wave. (5%)
- (B) At some point and at some instant, the electric field has its maximum value of 600 N/C and is directed along the y axis. Calculate the magnitude and direction of the magnetic field at this position and time. (5%)

3. (A) Please plot and describe how the electric generator works by electromagnetism. (5%)

(B) What is the de Broglie wavelength (λ) of an electron with a kinetic energy of K . (5%)

[Use the symbol of h for Planck constant, m for rest mass of electron, e for electron charge]

4. Please write down the Maxwell's (four) equations in integral form. (10%)

5. The voltage output of an AC source is given by the expression $\Delta v = 141.4 \sin \omega t$, where Δv is in volts. Find the rms current in the circuit when this source is connected to a 100- Ω resistor. (10%)

6. In a purely inductive AC circuit, $L = 10.0$ mH and the rms voltage is 314 V. Calculate the inductive reactance and rms current in the circuit if the frequency is 50.0 Hz. (10%)

7. Consider a uniformly wound solenoid having N turns and length ℓ . Assume ℓ is much longer than the radius of the windings and the core of the solenoid is air. (10%)

(A) What is the inductance (L) of the solenoid? (The permeability in free space is μ_0)

(B) What's the self-induced emf (\mathcal{E}_L) in the solenoid if the current it carries decreased at the rate of dI/dt ?

8. A capacitor of capacitance C is discharging through a resistor of resistance R . (10%)

(A) In terms of the time constant $\tau=RC$, when will the charge on the capacitor be half its initial value?

(B) When will the energy stored in the capacitor be half its initial value?

9. Determine the electric field E caused by a spherical cloud of electrons with a volume charge density $\rho = -\rho_0$ for $0 \leq R \leq b$ (both ρ_0 and b are positive) and $\rho = 0$ for $R > b$ in the free space (the permittivity of the free space is ϵ_0). (10%)

(A) find $E(R)$ for $0 \leq R \leq b$

(B) find $E(R)$ for $R > b$