※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. (1) Prove that a vector field **B** is solenoidal or divergenceless if $\nabla \cdot \mathbf{B}=0$ and provide the explanation with the physical example. **(10%)**
   (2) Prove that a vector field **B** is irrotational or conservative if $\nabla \times \mathbf{B}=0$ and provide the explanation with the physical example. **(10%)**

2. An electric field of 5 mV/m is applied on a wire of diameter 2 mm and conductivity 8×10^{6} S/m with 10^{28} free electrons per m^3 inside. Find (1) the current in the wire and (2) the drift velocity of the electrons. Assume electronic charge is -1.6×10^{-19} C. **(20%)**

3. Write down four Maxwell's equations in differential form and integral form and simply explain the physical meaning of these four equations. **(20%)**

4. A distortionless transmission line has the characteristic impedance = 50 Ω, attenuation constant (α)=0.05 Np/m, and wave velocity (u)=2×10^{8} m/s. Find the line parameters R(resistance per length), L(inductance per length), G(conductance per length), and C(capacitance per length) operating at 200 MHz. Note that $u=\omega/\beta$, where β is phase constant. **(20%)**

5. A voltage 20 sin (10^{3}t) V is applied to a parallel-plate capacitor with plate area of 4 cm^2 and plate separation of 2 mm. Find the displacement current. Assume permittivity(ε)=1.2×10^{-11} F/m. **(20%)**