系所組別：生物醫學工程學系乙組

考試科目：電磁學

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Radars are useful electromagnetic devices for detecting and locating the targets in military applications. A radar system is assumed to radiate 200 kW at 3 GHz in S-band. If the effective area of this radar antenna is 9 m^2, determine its directive gain, and the signal power density at a distance of 150 km. With a 20 m^2 target at 550 km, calculate the power of the reflected signal at the radar. (15%)

2. A parallel-plate capacitor with the plate area of 10 cm^2 and plate separation of 5 mm is applied by a voltage 50 $sin(10^3 t)$V. The relative permittivity of material inside the capacitor is 2. Calculate the displacement current inside the capacitor, and the conduction current in the connecting metal wire between the voltage source and parallel-plate capacitor. (10%)

3. A U-shaped electromagnet as shown in Fig. 1 is designed to lift a 500 kg mass including the keeper. The iron yoke with the relative permeability of 5000 has a cross section of 40 cm^2 and mean length of 50 cm, and the air gaps are each 0.1 mm long of both sides. Neglecting the reluctance of the keeper, calculate the number of turns needed in the coil when the applied current is 2 A. (10%)

4. Clearly state (a) the Helmholtz's theorem, (b) the solenoidal vector field, and (c) the irrotational vector field with words and equations. (15%)

5. In a free space, a point charge Q is placed at a distance d above an infinite conducting plane at y=0. (a) Derive the potential V at a point $P(x, y, z)$ if the conducting plane has a nonzero potential V_o. (b) Determine the electrostatic force of attraction between the charge Q and the conducting plane. (20%)

6. The bar AA' in Fig. 2 serves as a conducting path for the current I in two very long parallel lines. The lines have a radius a with the separation d. Find both the direction and magnitude of the magnetic force on the bar. (10%)

7. A thin conducting wire is bent into the shape of a regular polygon of N sides. Assume that b is the radius of the circle circumscribing the polygon and $\vec{n}$ is a unit vector normal to the plane of the polygon. If a current I flowing in the wire, show the magnetic flux density at the center in vector representation. Show also that the magnetic flux density as N goes to infinitive. (20%)

(背面仍有題目，請繼續作答)

系所組別：生物醫學工程學系乙組

考試科目：電磁學

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

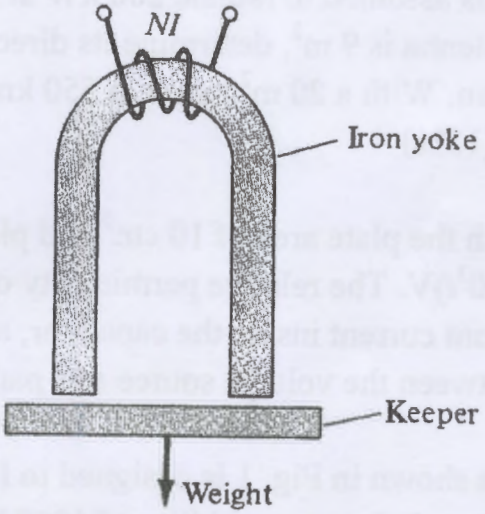

Fig. 1

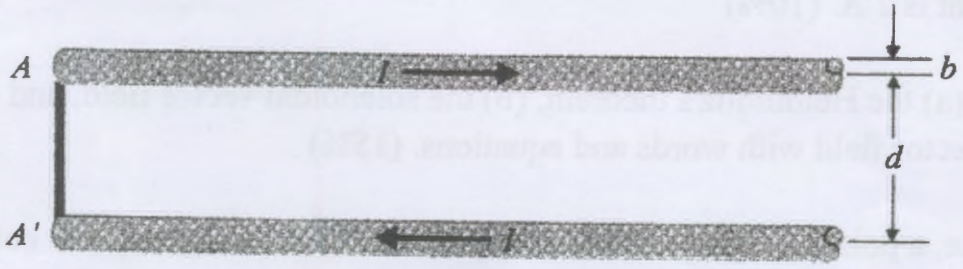

Fig. 2