Rami wail Shoula
201600112

Naneng 307
Assignment 3

1 a) Magnetic field strength $H = \frac{NI}{L} = \frac{(200)(10)}{0.20} = 10000 \ A/m$

b) In vacuum; $B_0 = \mu_0 H = (1.2566 \times 10^{-6} H/m)(10\,000 \ A/m) = 1.2566 \times 10^{-2}$ Tesla

c) Here, $B = \mu_0 H + \mu_0 M = \mu_0 H + \mu_0 \chi_m H = \mu_0 H(1 + \chi_m)$

$\therefore B = 1.2566 \times 10^{-2} \cdot [1 + 1.81 \times 10^{-4}] = 1.2569 \times 10^{-2}$ Tesla

d) Magnetization $M = \chi_m H = (1.81 \times 10^{-4})[10\,000 \ A/m] = 1.81 \ A/m$

2 a) A major disadvantage for piezolectric systems is difficult transmission to rotating actuator because both primary and secondary coil needed. For magnetorestrictive materials, only one coil is needed. Thus, magnetorestrictive can increase enegy efficiency by lowering rotating mass of the tool. Also, curie temperature is higher for magnetorestrictive material. Hence, operating range can be greater.

b) Soft magnetic:	Hard magnetic:
· Have smaller area enclosed by hysteresis loop	- Have larger area enclosed by hysteresis loop
· Low remnant magnetization	· High remnant magnetization
· Low coercivity	· High coercivity
· High initial permeability	· Low initial permeability
· Hysteresis loss is less	· Hysterisis loss is higher
· used for transformers, motors, electromagnetics	· used for permanent magnets, magnetic detectors, speakers, microphones

3 Bismuth: $\chi_m = -16.6 \times 10^{-5}$, $\because \chi_m$ is small & -ve $\therefore$ diamagnetic

$M = \chi_m H = \chi_m \frac{B_0}{\mu_0} = -(16.6 \times 10^{-5})(1 \ wb\, m^{-2}) / (4\pi \times 10^{-7} \ wb\, m^{-1} A^{-1}) = -132.094 \ Am^{-1}$

in -ve x-direction.

Magnetic field $= B_0 + \mu_0 M = B_0[1 + \chi_m] = [1T][1 - 16.6 \times 10^{-5}) = 0.999834 \ T$

Aluminum: $\chi_m = 2.3 \times 10^{-5}$, $\because \chi_m$ is small & +ve $\therefore$ paramagnetic.

$M = \chi_m H = \chi_m \frac{B_0}{\mu_0} = (2.3 \times 10^{-5})(1) / (4\pi \times 10^{-7}) = 18.303 \ Am^{-1}$

in +ve x-direction

magnetic field $= B_0 + \mu_0 M = B_0[1 + \chi_m] = (1T)[1 + 2.3 \times 10^{-5}] = 1.000023 \ T$

4. Curie Temp: Temperature at which certain magnetic materials undergo (T_c) a sharp change in magnetic properties, for ferromagnetism: $\chi = C/(T-T_c)$
Above T_c, material behaves like paramagnetic.

Bohr magneton (β): Elementary unit of magnetic moment on atomic scale, equal to magnetic moment of one electron spin along applied magnetic field.

$$\beta = \frac{e\hbar}{2m_e}.$$

· Magnetoresistance: The change in resistance of magnetic material when it is placed in a magnetic field.

5. Magnetic recording is widely used in magnetic disks or hard disk drives (HDD). Information is recorded as magnetization patterns on thin-film magnetic medium. Digital information is recorded and converted into current pulses that flow into a miniature electromagnet write element with a very small air gap. Electrical signal is stored as spatial magnetic pattern in circular tracks. Advanced technology include Longitudinal magnetic recording (LMR), GMR storage utilizing CPP and PMR modes.