Numericals on Sensors

Q.1: Calculate the length of an iron rod which can be used to produce ultrasonic waves of 20 KHz. Given, Y= 11.6×10^{10} N/m^2 and $\rho = 7.23 \times 10^3$ kg/m^3.

Q.2: Calculate the natural frequency of a pure iron rod of 40 mm length. The density of pure iron is 7.25×10^3 kg/m^3 and its Young modulus is 115×10^9 N/m^2. Can the magnetostriction oscillator produce ultrasonic waves with this rod? Comment on the result.

Q.3: Find the natural frequency of vibrations of a quartz plate of thickness 1.8 mm. Given, Y= 8×10^{10} N/m^2 and density =2650 kg/m3. Also calculate the change in the thickness required if the same plate is to be used to produce ultrasonic waves of frequency 2 MHz.

Q.4: Certain piezoelectric crystal of thickness 4 mm produces ultrasonic waves of frequency 400 KHz. Calculate the thickness of this crystal to produce ultrasonic frequency of 500 KHz.

Q.5: For Fe-Cu thermocouple, the neutral temperature is 285 °C when the cold junction temperature is 0 °C. Calculate the temperature of inversion if the cold junction temperature is -30 °.

Q.6: Calculate thermos emf of Sb-Au thermocouple whose junctions are at 0 °C and 100 °C. Given the Seebeck coefficients *a* and *b* for Sb and Au as, $a_{Sb\text{-}Pb}$=35.58 μV/°C; $b_{Sb\text{-}Pb}$=0.146 μV/°C^2; $a_{Au\text{-}Pb}$=2.90 μV/°C; $b_{Au\text{-}Pb}$=0.009 μV/°C^2.

Q.7: The thermo emf of a Cu-Fe thermocouple of 2160 μV when the cold junction is at 0 °C and the hot junction at 250 °C. Calculate the constants *a* and *b* if the neutral temperature is 330 °C.

Q.8: The thermo- electric power of iron is 17.5 micro Volt/ degree C at 0 C and 5 micro Volt/ degree at 125 C. The thermo electric power of cadmium is 3 micro Volt/ degree C at 0 C and 15 micro Volt/ degree C at 150 C. Calculate the neutral temperature of Iron Cadmium junction.

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