Vidyavardhini's College of Engineering and Technology, Vasai (West)

First Year Engineering

Academic Year: 2024-2025

Problem Set 4: Solid state sensors

Subject: BSC2023/EP **Date: 10/03/2025**
Max Marks: 10 **Submission Deadline: 21-03-2025**

CO4: To describe the significance of solid-state sensors.

Q. No.	Questions	Marks	CO	CL
1	(a) Explain Hall effect and derive expressions for the Hall voltage, Hall coefficient, and determine the charge carrier concentration. (b) A sample carries a current of $I = 5\text{mA}$ in a magnetic field of $B = 0.2\text{T}$. If the sample thickness is $d = 1\text{mm}$ and the charge carrier concentration is $n = 8 \times 10^{22}\text{m}^{-3}$, find the Hall voltage assuming electron charge $q = 1.6 \times 10^{-19}\text{C}$.	**4**	**4**	**2**
2	(a) A quartz crystal has a thickness of $t = 1\text{mm}$, Young's modulus $E = 7.9 \times 10^{10}\text{Pa}$, and density $\rho = 2.65 \times 10^{4}\text{kg/m}^3$. Calculate the fundamental and first harmonic frequency of ultrasonic vibrations. (b) A piezoelectric generator has an inductor of $L = 2\text{mH}$ and a capacitor of $C = 5\text{nF}$. Calculate the frequency of oscillation.	**4**	**4**	**2**
3	(a) An ultrasonic pulse is sent toward a wall and the echo is received after 0.02s. If the speed of sound is 343m/s, determine the distance of the wall.	**2**	**4**	**2**

NB: The semiconductor is the brain within the head. The software is the wisdom. And data is the knowledge. Chips will continue to shrink, of course! – *Isamu Akasaki*