## PROBLEM SET \#6

Issued: Wednesday, April 13, 2016
Due: Friday, April 22, 2016, 8:00 a.m. in the EE C247B homework box near 125 Cory.
This homework assignment continues from Problem Set \#5. Use the geometric dimensions and material properties given in Problem Set \#5 whenever needed.


Fig. PS6-1 - Top view of the accelerometer given in Problem Set \#5 with circuit connections.

1. Derive an expression for the capacitance between port $A$ and $B$ shown in Fig. PS6-1 as a function of displacement $x$ using a parallel-plate approximation. Also, calculate the overlap capacitance between these two ports at rest.
2. Derive an expression for the capacitance between port $A$ and $C$ shown in Figure PS6-1 as a function of displacement $y$ using a parallel-plate approximation. Also, calculate the overlap capacitance between these two ports at rest.
3. Suppose the accelerometer is now hooked up as shown in Figure PS6-1, with a DC bias $V_{\text {bias }}$ of 10 V applied to the structure.
i) Calculate the new $x$ - and $y$-directed resonance frequencies with this DC bias.
ii) If a sinusoidal force signal is applied to the structure in the $x$-direction with a magnitude of 1 g , what will be the magnitude and phase of the resulting output current $i_{B}$ as a function of frequency?
iii) If a sinusoidal force signal is applied to the structure in the $y$-direction with a magnitude of 1 g , what will be the magnitude and phase of the resulting output current $i_{C}$ as a function of frequency?
