

6.728 Applied Quantum and Statistical Physics:

Department of Electrical Engineering and Computer Science
Massachusetts Institute of Technology

PROBLEM SET 6

Problem Set Out: 10/18/06

Problem Set Due: 10/25/06 at the beginning of class

Problem 6.1 *Quantum LC Circuit in different variables*

(e) The Hamiltonian of the *LC* circuit can also be written as

$$H = \frac{1}{2}CV^2 + \frac{1}{2} \frac{\Phi^2}{L}$$

where Φ is the flux in the inductor. Show that the Hamiltonian can be written with the flux as the variable as

$$H = \frac{P_\Phi^2}{2M_\Phi} + \frac{1}{2}M_\Phi\omega^2\Phi^2$$

By analogy with the Simple Harmonic Oscillator find M_Φ and $P_\Phi = M_\Phi d\Phi/dt$ and show that $P_\Phi = Q$, where Q is the charge on the capacitor.

Problem 6.2 Text Problem 15.2 *A variational problem for a MOSFET*

Problem 6.3 Text Problem 16.2 *A finite basis set expansion.*