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Spring 2015

ELEC 318 – *Electromagnetic Fields*

Lecture 8(c)

Review for Final Exam
Part 3

THE CITADEL, THE MILITARY COLLEGE OF SOUTH CAROLINA
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Piezo-Resistivity

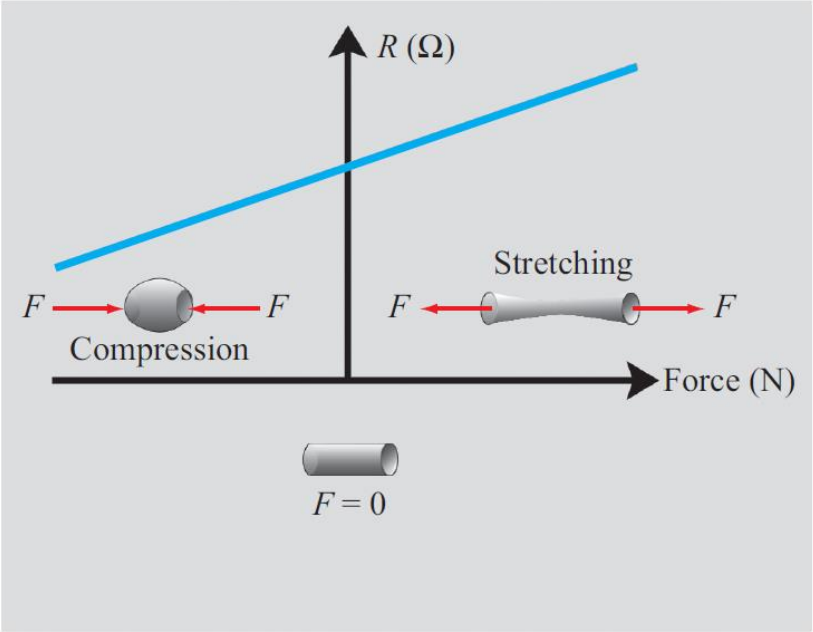


Figure TF7-2: Piezoresistance varies with applied force.

$$R = R_0\left(1 + \frac{\alpha F}{A_0}\right)$$

R_0 = resistance when $F = 0$
F = applied force
A_0 = cross-section when $F = 0$
α = piezoresistive coefficient of material

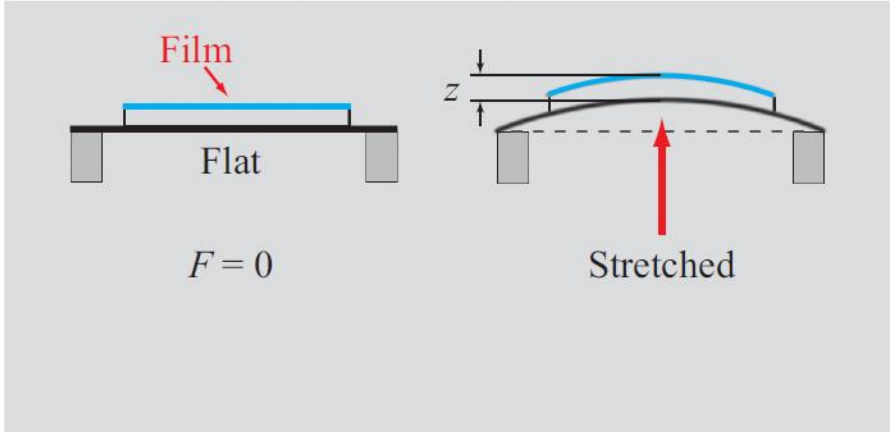
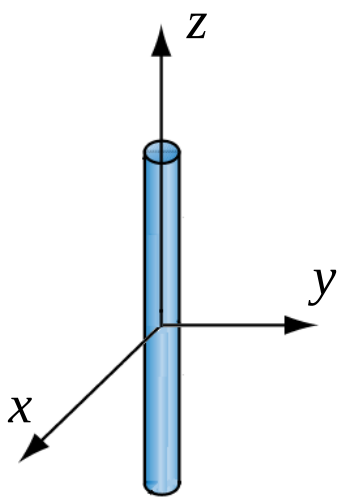


Figure TF7-3: Piezoresistor films.

Example: Charge Density vs. Charge

Calculate the total charge Q contained in a line charge extending from $z = -5$ m to $z = +5$ m, and whose charge density is $\rho_l = 2|z|$ (C/m).



Faraday Accelerometer

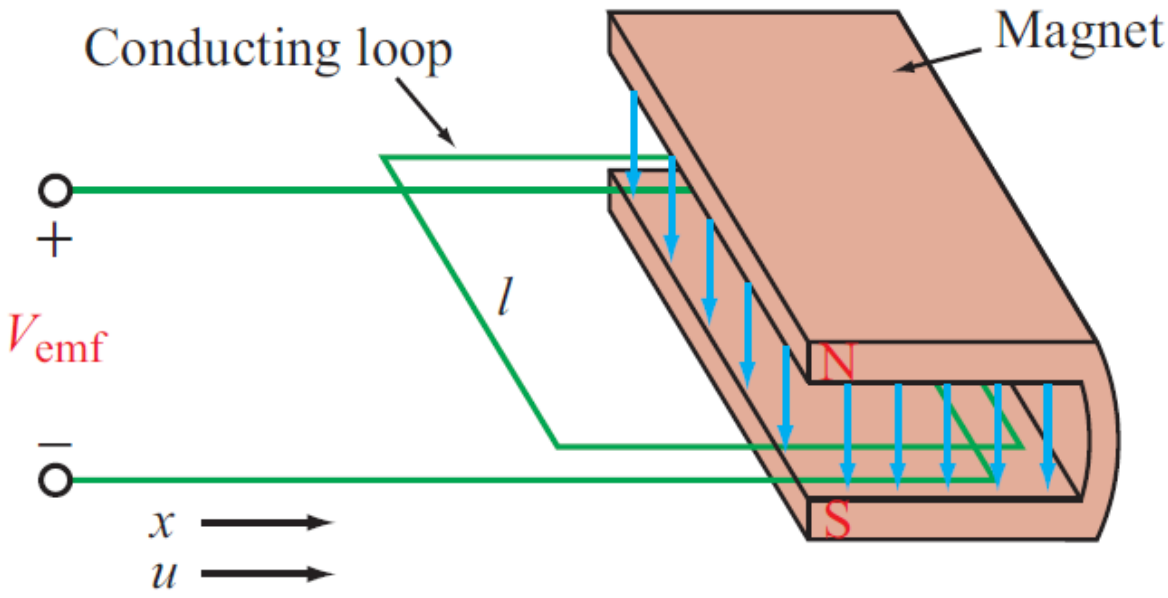


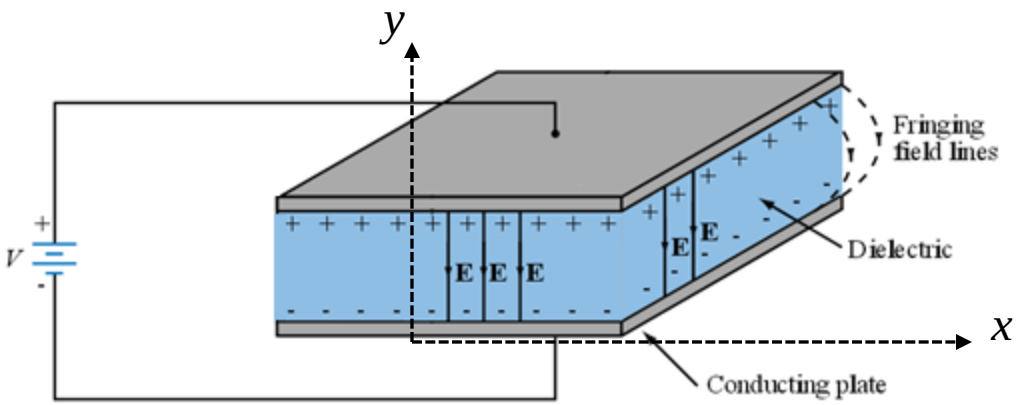
Figure TF12-3: In a Faraday accelerometer, the induced emf is directly proportional to the velocity of the loop (into and out of the magnet's cavity).

The acceleration **a** is determined by differentiating the velocity u with respect to time

Example: Potential & Electric Field

An electric field in space is defined by

$$\mathbf{E} = -2.5\,\hat{\mathbf{y}}\,\frac{\text{V}}{\text{cm}}$$



Evaluate the potential difference from $P(x = 2\text{ cm}, y = 0)$ to $Q(x = 0, y = 2\text{ cm})$.

$$\hat{\mathbf{x}} = \cos\phi\,\hat{\mathbf{r}} - \sin\phi\,\hat{\boldsymbol{\phi}}$$

$$\hat{\mathbf{y}} = \sin\phi\,\hat{\mathbf{r}} + \cos\phi\,\hat{\boldsymbol{\phi}}$$

Radio-Frequency Identification

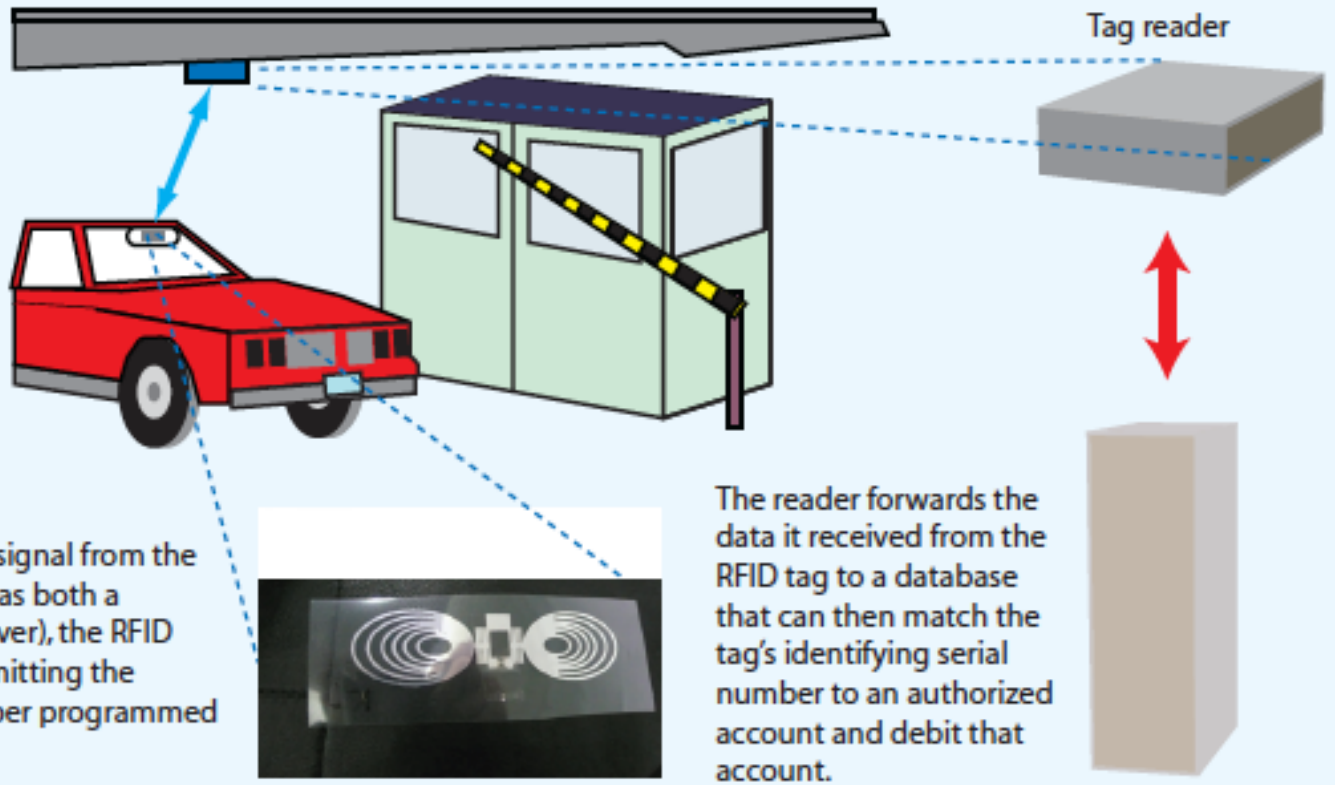


Figure TF13-2 How an RFID system works is illustrated through this EZ-Pass example. The UHF RFID shown is courtesy of Prof. C. F. Huang of Tatung University, Taiwan.

Example: Electrostatic Energy

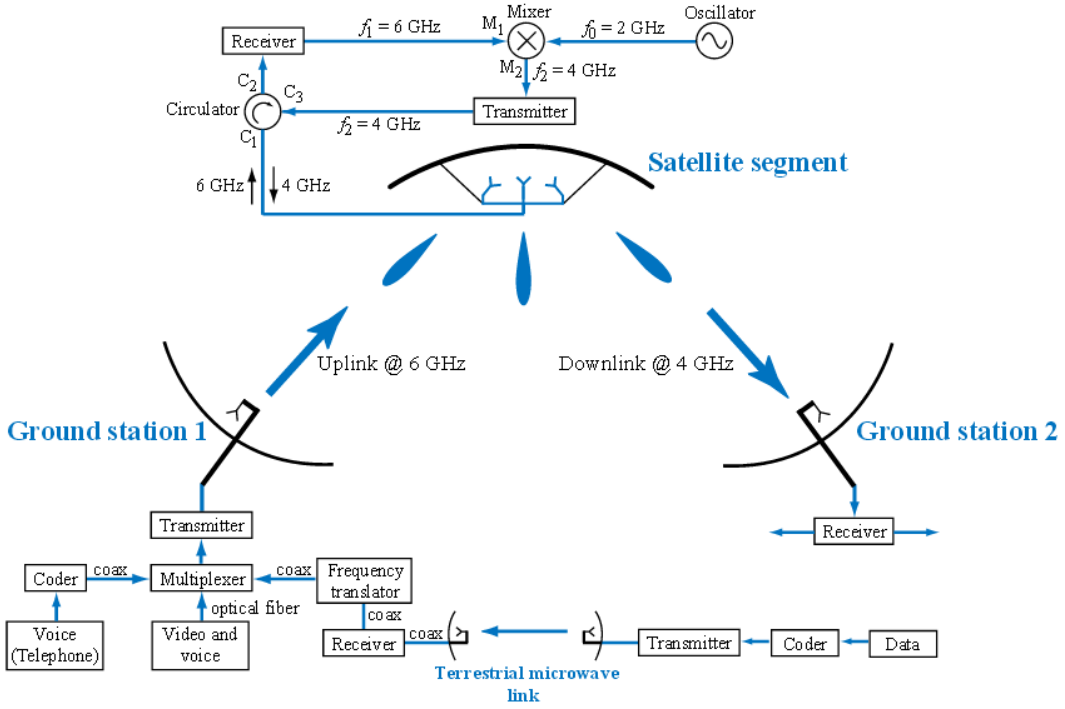
Along the surface of a conducting sphere is a uniform charge density of 10 nC/m^2. The sphere has a radius of 10 cm .

Calculate the electrostatic energy that is stored in this system. Assume $\varepsilon = \varepsilon_0$.

Electromagnetic Fields

-- a branch of physics or electrical engineering in which electric & magnetic phenomena are studied

- microwaves
- radio frequencies, lasers
- antennas
- electrical machines
- nuclear research
- fiber optics
- interference & compatibility
- energy conversion
- radar meteorology
- remote sensing
- induction heating



$$\nabla \cdot \mathbf{D} = \rho_v \qquad \nabla \times \mathbf{E} = -\frac{\partial}{\partial t}\mathbf{B}$$

$$\nabla \cdot \mathbf{B} = 0 \qquad \nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial}{\partial t}\mathbf{D}$$