Midterm Survey from PHYS 408 Spring 2010

SCALE
(1) very well
(2) fairly well
(3) tolerable
(4) badly
(5) awful

Q: In class, my group is working together
A: average of 1.6

SCALE
(1) strongly agree
(2) agree
(3) neutral
(4) disagree
(5) strongly disagree

Q: I am learning a great deal in this course
A: average of 1.7

Exit Survey from PHYS 408 Spring 2010

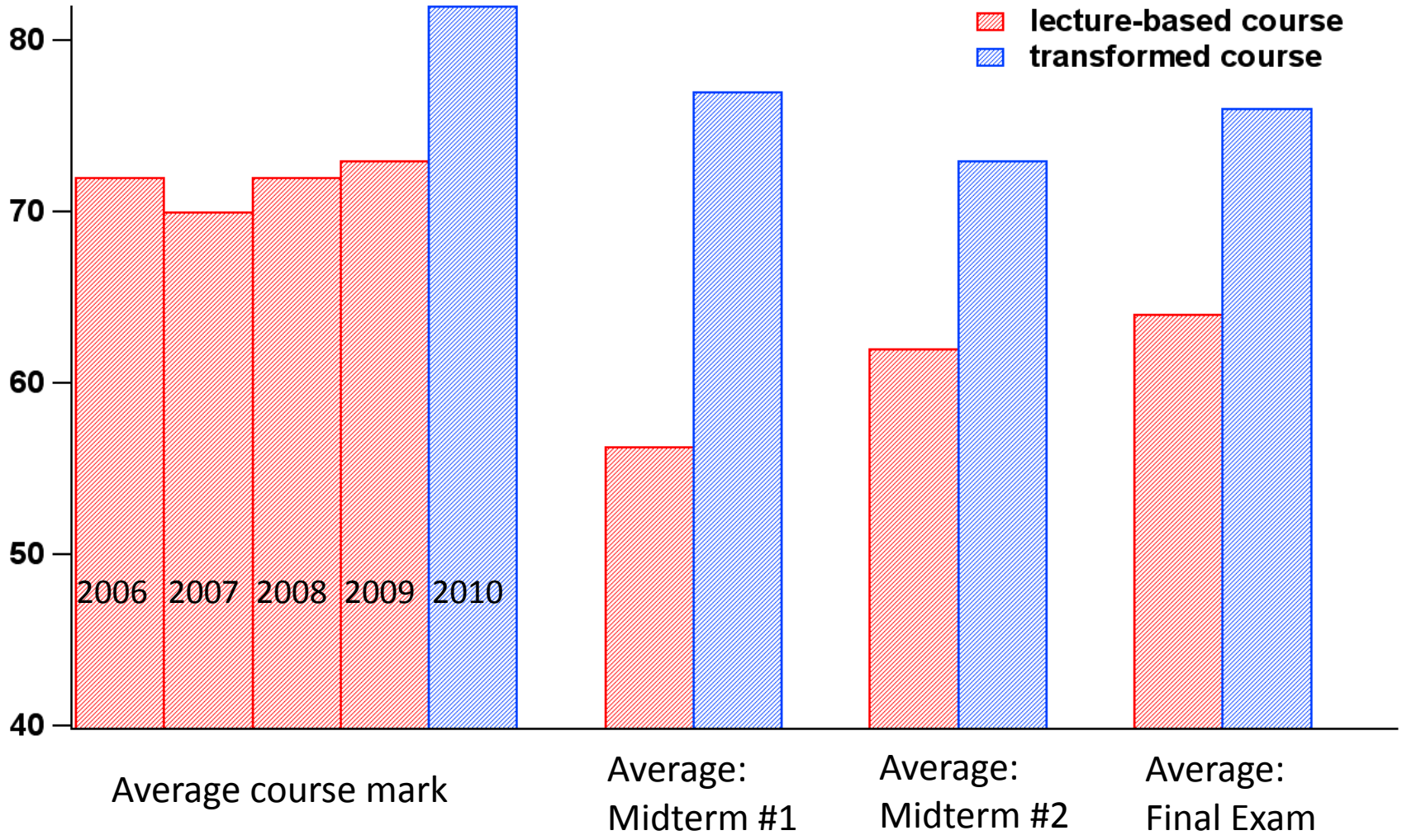
SCALE
(1) very useful
(2) useful
(3) somewhat useful
(4) not very useful
(5) worthless

Q: Rank the following on their contribution to your learning.
-in class activities: average of 1.2
-pre-reading: average of 1.6

SCALE
(1) strongly agree
(2) agree
(3) neutral
(4) disagree
(5) strongly disagree

Q: I learned a great deal in this course
A: average of 1.4

Results from this “new” teaching style



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pwd: Gr8stuff

Maxwell's equations and solutions

- exact, approximate, and realistic solutions of propagating light waves

(we'll be able to model with good accuracy laser beam propagation, etc.)

- interference of light

(devices: optical switches, high precision distance measurements)

- dispersion

(why do prisms produce a rainbow, limitations of optical fiber communication networks, etc.)

Fourier Optics

- understand the physics behind Fourier transforms

(what all those terms in those nasty Fourier integrals physically mean)

- optical image processing with lenses

(phase contrast microscopes, analog –no computer-- image processing)

Polarization

- visualization of polarized nature of E&M waves

(How do present day 3-D technology in movies use polarization)

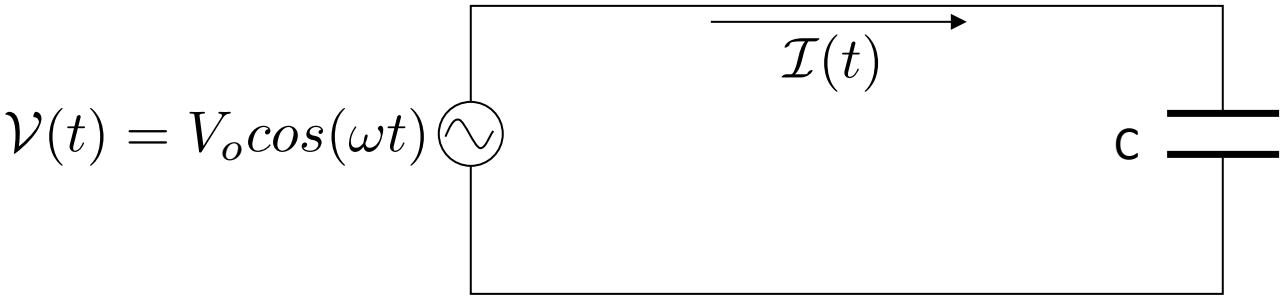
Optical Resonators

- what it is, different configurations, etc.

(Why needed to build a laser, how resonators are used to characterize light, perform precision measurements)

PHYS 408 Group Activities for Jan 4 2011

Please complete these exercises on your OWN piece of paper. If you have questions talk with your group mates or raise your hand and Ellen or David will come to help



1) What is $\mathcal{I}(t)$? *[Hint: for a capacitor]*

2) In your own words describe how are the current and voltage related. What variables do they depend upon? Is there a phase shift?

3) Doing algebra and calculus with sines and cosines is cumbersome. One can use complex functions to represent $\mathcal{I}(t)$ and $\mathcal{V}(t)$ to make the math easier. With this approach you might remember from previous courses that a capacitor has an impedance $Z = \frac{1}{i\omega C}$ where $Z = \frac{V}{I}$.

   Are I and V here the same as the $\mathcal{I}(t)$ and $\mathcal{V}(t)$ above? If not, how are they related mathematically? Make sure I and V are time independent. What I am looking for is the transform between the two representations. Which pair gives a physical description of the current and voltage in the circuit? Show that the above expression for the impedance is correct.

Bonus: give an example of when $Z = \frac{V}{I}$ isn't true for the Z above

1) $$I(t) = C \frac{d}{dt} V_0 \cos \omega t$$

$$= -C\omega V_0 \sin \omega t$$

2) The current is frequency dependent

The current leads the voltage by 90° in phase

Thus the impedence of the capacitor is frequeny dependent & shifts the phase

3) I & V from $\frac{V}{I} = Z = \frac{1}{i\omega C}$ are not the same as $I(t)$ & $V(t)$.

$I(t)$ & $V(t)$	I & V
- actual voltage & current	- a complex number
- real numbers	- a representation of the voltage & current
- time dependent	- no time depeudence

For $V(t) = V_0 \cos(\omega t + \phi_0)$,

The relationship between $V(t)$ & V is:

$V(t) \rightarrow V$

$$V(t) = \frac{V_0}{2}\left[e^{i(\omega t + \phi_0)} + e^{-i(\omega t + \phi_0)}\right]$$

by choice we take positive frequency component

$$\Rightarrow V = \frac{V_0}{2}$$

For $D(t) = V_0 \cos(\omega t + \phi_0)$, The relationship between $D(t)$ & V is:

$$D(t) = \frac{V_0}{2} e^{i\phi_0} e^{i\omega t} + \frac{V_0}{2} e^{-i\phi_0} e^{-i\omega t}$$

$$= \frac{V}{2} e$$

by choice we take everything in front of $e^{i\omega t}$ (i.e. the positive frequency component)

$$\therefore V = \frac{V_0}{1} e^{i\phi_0}$$

notice V is a complex # has no time dependence $\Rightarrow$ Thus is <u>not</u> the actual voltage but rather a <u>representation</u> of the voltage

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For $V = \frac{V_0}{1} e^{i\phi_0}$ to find $D(t)$

1) add $e^{i\omega t}$ & take Real part

so $D(t) = Re[V e^{i\omega t}]$

$= Re[V_0 e^{i\phi_0} e^{i\omega t}]$

$= V_0 \cos(\omega t + \phi_0)$ ← back where we started!

For $V(t) = V_0 \cos(\omega t + \phi_0)$ to find the time independent V (i.e. a complex # representation of $V(t)$)

$$V(t) = \frac{V_0}{2} e^{i\phi_0} e^{i\omega t} + \frac{V_0}{2} e^{-i\phi_0} e^{-i\omega t}$$

$$= \frac{V}{2} e^{i\omega t} + \frac{V^*}{2} e^{-i\omega t} \quad \text{w/ } V = V_0 e^{i\phi_0}$$

notice V is a complex #, has no time dependence

↳ This is not the actual voltage but rather a representation of the voltage

to transform from $V \rightarrow V(t)$

2 ways: ① $V(t) = \frac{V}{2} e^{i\omega t} + \frac{V^*}{2} e^{-i\omega t}$

② $V(t) = Re\left[V e^{i\omega t}\right]$

$= Re\left[V_0 e^{i\phi_0} e^{i\omega t}\right]$

$= V_0 \cos(\omega t + \phi_0)$ ← back where we started.

So the bottom line is we solve for the voltage & current w/ I, V & then use ↑ to get actual voltage & current.

The reasons why: ① work w/ time independent quantities

② Calculus much easier

$\frac{d}{dt} \rightarrow i\omega$

The limitations

① only works for linear systems

② only works for steady state

③ only works for single frequencies

We will be using a very similar approach w/ electric fields