First Midterm Exam, Tuesday, September 24

The First Midterm Exam will cover material through our discussion of solutoins to the wave equation. The exam will consist of 6-8 short-to-medium length problems similar to the problem assignments. Therefore the problems are your best study guide.

You may bring a 3×3 card with formulas; you may use both sides. Bring a pen/pencil. Paper will be provided.

Problems Brief synopsis of problems assigned so far. Pay attention to the general topics covered in the problems, not the specific problems.

1.2 Potential energy, small oscillations

1.4 SHO with sign flip–exponential divergence

1.5 Absolute value and phase of complex numbers

1.6 z, z^2 in $x + iy$ and polar form

1.8 When is $q(t) = Ae^{i\omega t} + Be^{-i\omega t}$ real?

1.9 Relation between $Re(q)$ and $Im(q)$

1.11 $\cos(\alpha + \beta)$ and $\sin(\alpha + \beta)$

1.18 Derive Euler formula from Taylor series and by solving $f'' + f = 0$ two ways.

T 2.1 Two-dim SHO

T 2.3 Complex solutions to characteristic equation

T 2.5 Show that the $N = 2$ limit of the general N oscillator case reduces to our solution for two oscillators

T 2 .6 Three coupled oscillators, complete solution

R 2.6 Write complex numbers in Cartesian form

R 2.7 Write complex numbers in polar form

R 3.1 Invert the Euler formula to derive expressions for $\cos x$ and $\sin x$

T 3.1 Show that $\cos(\omega t)\cos(kx) + i\sin(\omega t)\sin(kx)$ where $\omega = kc$ solves the wave equation. With $A = B$ show that $q(t) = A\cos(k(x - ct))$.

T 3.2 Change of variables and chain rule for $q = te^x$, $u = x + ct$ and $s = x - ct$.

T 3.3 Show that $q(x,t) = f(x - ct) + g(x + ct)$ solves the wave equation

T 3.4 Find solutions to the wave equation with various initial conditions.

R 4.1 Apply the inverse transformation to the normal mode solution to get $\mathbf{x}(t)$

R 4.3 With 0 initial position, find the initial velocities that lead to only the second mode

R 6.3 Show that the sum of $\cos(\omega t)\cos(kx)$ and $\sin(\omega t)\sin(kx)$ is a traveling wave. Which direction?

R 8.1 Partial derivatives directly and using chain rule

W Find the eigenvalues and eigenvectors of $M = \begin{pmatrix} 3 & 4 \\ 4 & 3 \end{pmatrix}$.