

## PDE Problem Help

Many of you are short cutting your solutions and losing points in your HWs, so I'm giving you a brief outline to help you make sure you obtain points. This will be particularly important for **Exams**.

The list below are steps that need displaying in many of your PDE problems.

1. Show *separation of variables* for any PDE given.
2. List every ODE resulting from the separation of variables, noting which one is the Sturm-Liouville (SL) problem and giving both the ODE and boundary conditions (BCs).
3. Solve the SL problem. If the problem has been solved previously, then you can cite where it was solved. Otherwise, you must demonstrate **all** possibilities for the separation constant with theorems like the Rayleigh-Quotient, showing  $\lambda \geq 0$ , or proving  $\lambda = 0$  is or isn't an eigenvalue (e.v.). In the future, some problems will have more SL problems to solve, and not just one.
4. Solve the other ODE with the e.v.s found from the SL Problem.
5. Show explicitly the product solution, then write the solution from the superposition principle.
6. Find the Fourier coefficients clearly indicating what orthogonality you used. Once again you can shorten your answer by clearly stating we showed certain orthogonality or that the SL theorem gives orthogonality. Present clearly the normalization factor that arises from your particular solution of the SL problem, as future problems won't always be  $L/2$ .
7. Note that some of the text problems give you some of these conditions, so clearly state that the problem gives you a particular result listed above.