PHYS 373 (Spring 2015): Mathematical Methods for Physics II
Final exam: Monday, May 18, 10.30 am.-12.30 pm.

Read the instructions below and do *not* flip to next page till you are told to do so.

Name:

Student ID:

Useful formulae:

$f(x)=\frac{a_0}{2}+\sum_1^\infty\left(a_n\cos\frac{n\pi x}{l}+b_n\sin\frac{n\pi x}{l}\right)$	$f(x)=\sum_{l=0}^\infty c_l P_l(x)$	$f(x)=\sum_{-\infty}^{\infty} c_n e^{in\pi x/l}$
$P_l^m(x)=\left(1-x^2\right)^{m/2}\frac{d^m}{dx^m}P_l(x)$	$a_n=\frac{1}{l}\int_{-l}^{l} f(x)\cos\frac{n\pi x}{l}dx$	$P_3(x)=\frac{1}{2}\left(5x^3-3x\right)$
$\int_0^1 xJ_p(\alpha x)J_p(\beta x)=0\ (\alpha\neq\beta)$	$b_n=\frac{1}{l}\int_{-l}^{l} f(x)\sin\frac{n\pi x}{l}dx$	$P_1(x)=x$
$c_m=\frac{2m+1}{2}\int_{-1}^{1} f(x)P_m(x)dx$	$\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y},\ \frac{\partial v}{\partial x}=-\frac{\partial u}{\partial y}$	$P_0(x)=1$
$f(z)=f(x+iy)=u(x,y)+iv(x,y)$	$J_{p-1}(x)-J_{p+1}(x)=2J_p'(x)$	$J_0(0)=1$
$\frac{d}{dx}\left[x^{-p}J_p(x)\right]=-x^{-p}J_{p+1}(x)$	$N_n(0)=\infty$	$J_{n\neq 0}(0)=0$
$\frac{\partial^2}{\partial x^2}T(x,y)+\frac{\partial^2}{\partial y^2}T(x,y)=0$	$T=\left\{\begin{array}{c} e^{kx} \\ e^{-kx}\end{array}\right\}\left\{\begin{array}{c}\sin ky \\ \cos ky\end{array}\right\}$	or $\left\{\begin{array}{c}\sin kx \\ \cos kx\end{array}\right\}\left\{\begin{array}{c} e^{ky} \\ e^{-ky}\end{array}\right\}$
$R\left(z_0\right)=\lim_{z\to z_0}\left(z-z_0\right)f(z)$	$g(\alpha)=\frac{1}{2\pi}\int_{-\infty}^{\infty} f(x)e^{-i\alpha x}dx$	$J_n(\infty)=0$
$\frac{d^2}{dt^2}G\left(t,t'\right)+\omega^2 G\left(t,t'\right)=\delta\left(t-t'\right)$ for	$y''+\omega^2 y=f(t)$	$y_0=y_0'=0$
(residue of $f(Z)$at $Z=\infty$) $=$	$-\left(\text{residue of } \frac{1}{z^2}f\left(\frac{1}{z}\right) \text{ at } z=0\right)$	$\int_{t_0-\epsilon}^{t_0+\epsilon}\delta\left(t-t_0\right)dt=1$
$\int_{-\infty}^{\infty}\frac{P(x)}{Q(x)}e^{imx}$ (around $C,$ with $m>0$) $=$	$2\pi i$.sum of residues of $\frac{P}{Q}e^{imz}$	in upper half-plane
$\delta\left(t-t_0\right)=0,$ for $t\neq t_0$	$P_l(x)=\frac{1}{2^l l!}\frac{d^l}{dx^l}\left(x^2-1\right)^l$	$\int f(z)dz=0,$ around C
$ax^2+bx+c=0\rightarrow$	$x=\left(-b\pm\sqrt{b^2-4ac}\right)/(2a)$	$R\left(z_0\right)=\frac{g(z_0)}{h'(z_0)},$ if $f=\frac{g}{h}$

It is necessary to show the details of the derivation and not just the final answer for *all* problems.

This is a closed book exam: crib sheets are not allowed.

In case they are needed, more blank paper and stapes are provided.

Please write clearly and if you use the backside of a page, then please indicate so.

Check that there are total of 8 *pages* (2 cover pages + 6 problems).

Note that some problems have *multiple* parts; so, please read the statement of each problem carefully.

Remember the honor pledge that you signed at the start of the semester.

Problem #	Points scored	Maximum points
1		8
2		15
3		10
4		10
5		11
6		11
Total		65