EXAMINATION SH2314 Formula Sheet

$$f(x) \approx f(a) + \frac{f'(a)}{1!}(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \cdots$$

TABLE 2.1

Basic Fourier Transform Pairs

Signal	Fourier Transform
1	$\delta(u,v)$
$\delta(x,y)$	1
$\delta(x-x_0, y-y_0)$	$e^{-j2\pi(ux_0+vy_0)}$
$\delta_s(x,y;\Delta x,\Delta y)$	$\text{comb}(u\Delta x, v\Delta y)$
$e^{j2\pi(u_0x+v_0y)}$	$\delta(u-u_0, v-v_0)$
$\sin[2\pi(u_0x+v_0y)]$	$\frac{1}{2j}[\delta(u-u_0,v-v_0) - \delta(u+u_0,v+v_0)]$
$\cos[2\pi(u_0x+v_0y)]$	$\frac{1}{2}[\delta(u-u_0,v-v_0) + \delta(u+u_0,v+v_0)]$
$\text{rect}(x,y)$	$\text{sinc}(u,v)$
$\text{sinc}(x,y)$	$\text{rect}(u,v)$
$\text{comb}(x,y)$	$\text{comb}(u,v)$
$e^{-\pi(x^2+y^2)}$	$e^{-\pi(u^2+v^2)}$

TABLE 2.2

Properties of the Fourier Transform

Property	Signal	Fourier Transform
	$f(x,y)$	$F(u,v)$
	$g(x,y)$	$G(u,v)$
Linearity	$a_1f(x,y) + a_2g(x,y)$	$a_1F(u,v) + a_2G(u,v)$
Translation	$f(x-x_0, y-y_0)$	$F(u,v)e^{-j2\pi(ux_0+vy_0)}$
Conjugation	$f^*(x,y)$	$F^*(-u,-v)$
Conjugate symmetry	$f(x,y)$ is real-valued	$F(u,v) = F^*(-u,-v)$
		$F_R(u,v) = F_R(-u,-v)$
		$F_I(u,v) = -F_I(-u,-v)$
		$\lvert F(u,v)\rvert = \lvert F(-u,-v)\rvert$
		$\angle F(u,v) = -\angle F(-u,-v)$
Signal reversing	$f(-x,-y)$	$F(-u,-v)$
Scaling	$f(ax,by)$	$\frac{1}{\lvert ab\rvert}F\left(\frac{u}{a},\frac{v}{b}\right)$
Rotation	$f(x\cos\theta - y\sin\theta, x\sin\theta + y\cos\theta)$	$F(u\cos\theta - v\sin\theta, u\sin\theta + v\cos\theta)$
Circular symmetry	$f(x,y)$ is circularly symmetric	$F(u,v)$ is circularly symmetric
		$\lvert F(u,v)\rvert = F(u,v)$
		$\angle F(u,v) = 0$
Convolution	$f(x,y) * g(x,y)$	$F(u,v)G(u,v)$
Product	$f(x,y)g(x,y)$	$F(u,v) * G(u,v)$
Separable product	$f(x)g(y)$	$F(u)G(v)$
Parseval's theorem	$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\lvert f(x,y)\rvert^2\,dx\,dy = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\lvert F(u,v)\rvert^2\,du\,dv.$	