

# Sample Document Using Interchangable Numbering

Nicola Talbot

October 12, 2016

## **Abstract**

This is a sample document illustrating the use of the **glossaries** package. The functions here have been taken from “Tables of Integrals, Series, and Products” by I.S. Gradshteyn and I.M. Ryzhik.

The glossary lists both page numbers and equation numbers. Since the majority of the entries use the equation number, **counter=equation** was used as a package option. Note that this example will only work where the page number and equation number compositor is the same. So it won’t work if, say, the page numbers are of the form 2-4 and the equation numbers are of the form 4.6. As most of the glossary entries should have an italic format, it is easiest to set the default format to italic.

# Contents

<b>Special Functions</b>	<b>2</b>
<b>1 Gamma Functions</b>	<b>4</b>
<b>2 Error Functions</b>	<b>6</b>
<b>3 Beta Function</b>	<b>7</b>
<b>4 Chebyshev's polynomials</b>	<b>8</b>
<b>5 Hermite polynomials</b>	<b>9</b>
<b>6 Laguerre polynomials</b>	<b>10</b>
<b>7 Bessel Functions</b>	<b>11</b>
<b>8 Confluent hypergeometric function</b>	<b>12</b>
<b>9 Parabolic cylinder functions</b>	<b>13</b>
<b>10 Elliptical Integral of the First Kind</b>	<b>14</b>
<b>11 Constants</b>	<b>15</b>

# Index of Special Functions and Notations

Numbers in italic indicate the equation number, numbers in bold indicate page numbers where the main definition occurs.

Notation	Function Name	
$B(x, y)$	Beta function	<i>3.1–3.3</i>
$B_x(p, q)$	Incomplete beta function	<i>3.4</i>
$C$	Euler’s constant	<i>11.1</i>
$D_p(z)$	Parabolic cylinder functions	<i>9.1</i>
$\operatorname{erf}(x)$	Error function	<i>2.1</i> , <b>6</b>
$\operatorname{erfc}(x)$	Complementary error function	<i>2.2</i>
$F(\phi, k)$	Elliptical integral of the first kind	<i>10.1</i>
$G$	Catalan’s constant	<i>11.2</i>
$\Gamma(z)$	Gamma function	<i>1.1</i> , <i>1.2</i> , <i>1.5</i> , <b>4</b>
$\Gamma(\alpha, x)$	Incomplete gamma function	<i>1.4</i>
$\gamma(\alpha, x)$	Incomplete gamma function	<i>1.3</i>
$H_n(x)$	Hermite polynomials	<i>5.1</i>
$k_\nu(x)$	Bateman’s function	<i>8.2</i>
$L_n^\alpha(x)$	Laguerre polynomials	<i>6.1</i>

Notation	Function Name	
$\Phi(\alpha, \gamma; z)$	confluent hypergeometric function	<i>8.1</i>
$\psi(x)$	Psi function	<i>1.6</i>
$T_n(x)$	Chebyshev's polynomials of the first kind	<i>4.1</i>
$U_n(x)$	Chebyshev's polynomials of the second kind	<i>4.2</i>
$Z_\nu(z)$	Bessel functions	<i>7.1</i>

# Chapter 1

## Gamma Functions

The **gamma function** is defined as

$$\Gamma(z) = \int_0^\infty e^{-t} t^{z-1} dt \quad (1.1)$$

$$\Gamma(x+1) = x\Gamma(x) \quad (1.2)$$

$$\gamma(\alpha, x) = \int_0^x e^{-t} t^{\alpha-1} dt \quad (1.3)$$

$$\Gamma(\alpha, x) = \int_x^\infty e^{-t} t^{\alpha-1} dt \quad (1.4)$$

$$\Gamma(\alpha) = \Gamma(\alpha, x) + \gamma(\alpha, x) \quad (1.5)$$

$$\psi(x) = \frac{d}{dx} \ln \Gamma(x) \quad (1.6)$$

# Chapter 2

## Error Functions

The **error function** is defined as:

$$\text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt \quad (2.1)$$

$$\text{erfc}(x) = 1 - \text{erf}(x) \quad (2.2)$$



## Chapter 3

### Beta Function

$$B(x, y) = 2 \int_0^1 t^{x-1} (1-t^2)^{y-1} dt \quad (3.1)$$

Alternatively:

$$B(x, y) = 2 \int_0^{\frac{\pi}{2}} \sin^{2x-1} \phi \cos^{2y-1} \phi d\phi \quad (3.2)$$

$$B(x, y) = \frac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)} = B(y, x) \quad (3.3)$$

$$B_x(p, q) = \int_0^x t^{p-1} (1-t)^{q-1} dt \quad (3.4)$$

## Chapter 4

# Chebyshev's polynomials

$$T_n(x) = \cos(n \arccos x) \tag{4.1}$$

$$U_n(x) = \frac{\sin[(n+1) \arccos x]}{\sin[\arccos x]} \tag{4.2}$$

## Chapter 5

### Hermite polynomials

$$H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} (e^{-x^2}) \quad (5.1)$$

## Chapter 6

### Laguerre polynomials

$$L_n^\alpha(x) = \frac{1}{n!} e^x x^{-\alpha} \frac{d^n}{dx^n} (e^{-x} x^{n+\alpha}) \quad (6.1)$$

# Chapter 7

## Bessel Functions

Bessel functions  $Z_\nu(z)$  are solutions of

$$\frac{d^2 \textcolor{red}{Z}_\nu}{dz^2} + \frac{1}{z} \frac{dZ_\nu}{dz} + \left(1 - \frac{\nu^2}{z^2} Z_\nu = 0\right) \quad (7.1)$$

## Chapter 8

### Confluent hypergeometric function

$$\Phi(\alpha, \gamma; z) = 1 + \frac{\alpha}{\gamma} \frac{z}{1!} + \frac{\alpha(\alpha+1)}{\gamma(\gamma+1)} \frac{z^2}{2!} + \frac{\alpha(\alpha+1)(\alpha+2)}{\gamma(\gamma+1)(\gamma+2)} \frac{z^3}{3!} + \cdots \quad (8.1)$$

$$k_\nu(x) = \frac{2}{\pi} \int_0^{\pi/2} \cos(x \tan \theta - \nu \theta) d\theta \quad (8.2)$$

## Chapter 9

### Parabolic cylinder functions

$$D_p(z) = 2^{\frac{p}{2}} e^{-\frac{z^2}{4}} \left\{ \frac{\sqrt{\pi}}{\Gamma\left(\frac{1-p}{2}\right)} \Phi\left(-\frac{p}{2}, \frac{1}{2}; \frac{z^2}{2}\right) - \frac{\sqrt{2\pi}z}{\Gamma\left(-\frac{p}{2}\right)} \Phi\left(\frac{1-p}{2}, \frac{3}{2}; \frac{z^2}{2}\right) \right\} \quad (9.1)$$

## Chapter 10

### Elliptical Integral of the First Kind

$$F(\phi, k) = \int_0^\phi \frac{d\alpha}{\sqrt{1 - k^2 \sin^2 \alpha}} \quad (10.1)$$



# Chapter 11

## Constants

$$\textcolor{red}{C} = 0.577\,215\,664\,901\dots \tag{11.1}$$

$$\textcolor{red}{G} = 0.915\,965\,594\dots \tag{11.2}$$