College of Engineering and Computer Science
Mechanical Engineering Department

California State University Northridge

Mechanical Engineering 501A
Seminar in Engineering Analysis

Fall 2017 Number: 15966 Instructor: Larry Caretto

November 1 Homework Problems

1. Shift the index in the power series $\sum_{s=2}^{\infty} \frac{s(s+1)}{s^2+1} x^{s-1}$ so that the power under the summation sign is x^m. Verify your result by writing the first four terms for each form of the series. Determine the range of x for which the solution will converge; this is known as the radius of convergence for the series.

2. Find the two solutions for the differential equation $(x + 2)^2y'' + (x + 2)y' - y = 0$, using the Frobenius method.

3. Use the equation from Kreyszig that $\frac{d}{dx}\left[x^{-\nu} J_\nu(x)\right] = -x^{-\nu} J_{\nu+1}(x)$ to show that $\int x^{-\nu} J_{\nu+1}(x)dx = -x^{-\nu} J_\nu(x) + c$.

4. Using the substitutions $y = u\sqrt{x}$ and $z = kx^2/2$, show that the differential equation $y'' + k^2x^2y = 0$ reduces to Bessel's equation. Find a general solution to the original equation in terms of Bessel functions. (Hint: convert the given differential equation to one in which z is the independent variable and u is the dependent variable.)

5. The function $I_\nu(x) = i^{-\nu}J_\nu(ix)$, where $i^2 = -1$, is called the modified Bessel function of the first kind of order ν. Show that $I_\nu(x)$ is a solution of $x^2y'' + xy' - (x^2 + \nu^2)y = 0$.