1. Solve the following differential equation:

$$x^2 \frac{d^2 y}{dx^2} + 3x \frac{dy}{dx} + y - x^3 \log x = 0.$$

2. Solve the following differential equation:

$$(1+x)^2 \frac{d^2 y}{dx^2} + 3(1+x)\frac{dy}{dx} + y - (1+x)^3 \sin(\log(1+x)) = 0.$$

3. Use method of undetermined coefficients to solve the following differential equation

$$y'' - 2y' - 3y = e^{2t} + 3t^2 + 4t - 5 + 5\cos(2t).$$

4. Use method of undetermined coefficients to solve the differential equation

$$y'' + 4y = \cos(2x) + 5\sin(2x) + x^2 + e^{3x}.$$

5. Solve $\dfrac{d^2 y}{dx^2} - \dfrac{1}{x}\dfrac{dy}{dx} + \dfrac{5}{x^2}y = 5log(x)$, for $x > 0$.

6. Find the general solution to the following differential equation

$$y'' - 2y' + y = \frac{e^t}{t^2 + 1} + t^2 + 1.$$

7. Form the partial differential equation by eliminating arbitrary function f from $f\left(z^2 - xy, \frac{x}{z}\right) = 0.$

8. Form the partial differential equation by eliminating the arbitrary constants a and b from $\log(az - 1) = x + ay + b.$

9. Solve the partial differential equation $(z^2 - 2yz - y^2)p + (xy + zx)q = xy - zx.$

10. Solve $z(p^2 - q^2) = x - y$ using the substitution $Z = \frac{2}{3}z^{\frac{3}{2}}.$