Experiment-5

The equation for the motion of a viscous liquid in laminar flow in a tube of circular crosssection with radius R in its general form for an incompressible liquid is

$$\frac{\partial^2 w}{\partial r^2} + \frac{1}{r}\frac{\partial w}{\partial r} + \frac{1}{\mu}\frac{\partial p}{\partial z} = \frac{\rho}{\mu}\frac{\partial w}{\partial t} \qquad (1)$$

Where let $\frac{\partial p}{\partial z} = A^* e^{i\omega t}$, $w = ue^{i\omega t}$ then we obtain

$$\frac{d^2 u}{dr^2} + \frac{1}{r}\frac{du}{dr} - \frac{i\omega\rho}{\mu}u = -\frac{A^*}{\mu} \qquad (2)$$

Find its solution by the method of separation of variables, write the expression for velocity and plot the velocity profiles for the first four harmonics resulting from the pressure gradient *Cos wt* which oscillates sinusoidally and for α =2,3,4, and 6.