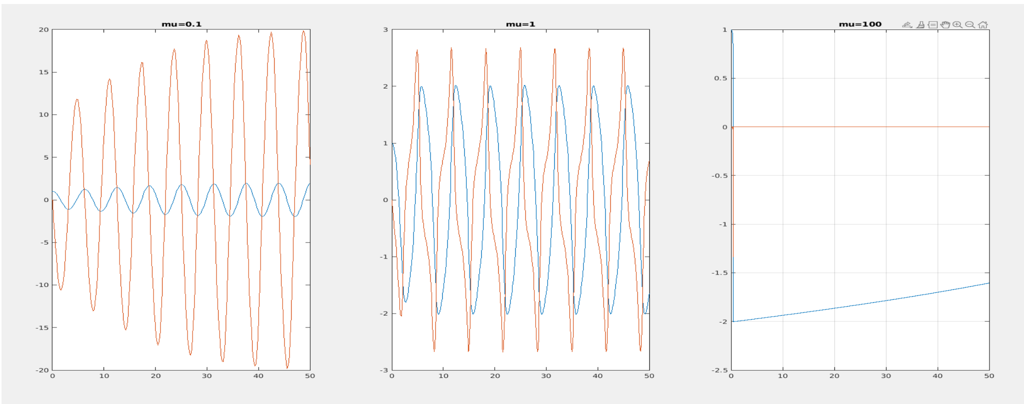
A. Raghavendra Kaushik - 18ME31003

a)Solving Differential Equations:-

Let us consider $dy/dt = \mu z$. Substituting this in the Vanderpol equation, we get $dz/dt = \mu(1 - y^2)z - y/\mu$. Hence we have converted a second-order equation to a system of 2 linear first-order differential equations.

b) On running “solvevdp_18ME31003.m”, we get 2 figures. The first figure contains solutions y and z for different values of μ. Here is the image obtained for a time ranging from 0 to 50.



c)Running code: On running “solvevdp_18ME31003.m”, we see that as μ increases, the time to solve increases. And at $\mu = 100$, it takes a long time due to stiffness. On changing the numerical method(by using ode15s), we get a considerable increase in speed(time span from 0 to 1000).

```
mu = 0.1
Elapsed time is 0.020136 seconds.
mu = 1
Elapsed time is 0.032837 seconds.
mu = 100 - ode45
Elapsed time is 0.573340 seconds.
mu = 100 - ode15s
Elapsed time is 0.054079 seconds.
```

d)Phase Plane analysis: From the below image, we see that difference in the rate of convergence depends on the value of μ. With a low value of μ like 0.1, the solution tries to converge quickly towards a point in a spiral fashion. While at μ = 1, the same is achieved but at a much slower rate. But at μ = 100, the system continues in a loop without converging. Phase plane diagram for a time span ranging from 0 to 1000.