April 12, 2023

Exercises in ODE and modeling MMG511/TMV162.

Exercises in stability by linearization

Investigate stability of the zero solution by linearization. Solve 3 of 5 exercises

899. $\begin{cases} x' = 2xy - x + y \\ y' = 5x^4 + y^3 + 2x - 3y \end{cases}$

900. $\begin{cases} x' = x^2 + y^2 - 2x \\ y' = 3x^2 - x + 3y \end{cases}$

901. $\begin{cases} x' = e^{x+2y} - \cos(3x) \\ y' = \sqrt{4+8x} - 2e^y \end{cases}$

902. $\begin{cases} x' = \ln(4y + e^{-3x}) \\ y' = 2y - 1 + \sqrt[3]{1-6x} \end{cases}$

903. $\begin{cases} x' = \ln(3e^y - 2\cos(x)) \\ y' = 2e^x - \sqrt[3]{8+12y} \end{cases}$

Answers: 899:stable; 900:unstable; 901: unstable; 902: stable; 903: unstable;

Find all equilibrium points and investigate their stability. Solve 4 exercises: 2 easier and 2 more complicated.

915. $\begin{cases} x' = y - x^2 - x \\ y' = 3x - x^2 - y \end{cases}$

916. $\begin{cases} x' = (x-1)(y-1) \\ y' = xy - 2 \end{cases}$

917. $\begin{cases} x' = y \\ y' = \sin(x+y) \end{cases}$

918. $\begin{cases} x' = \ln(-x + y^2) \\ y' = x - y - 1 \end{cases}$

919. $\begin{cases} x' = 3 - \sqrt{4 + x^2 + y} \\ y' = \ln(x^2 - 3) \end{cases}$

920. $\begin{cases} x' = e^y - e^x \\ y' = \sqrt{3x + y^2} - 2 \end{cases}$

921. $\begin{cases} x' = \ln(1 + y + \sin(x)) \\ y' = 2 + \sqrt[3]{3\sin(x) - 8} \end{cases}$

922. $\begin{cases} x' = -\sin(y) \\ y' = 2x + \sqrt{1 - 3x - \sin(y)} \end{cases}$

Answers: 915: (0,0) -unstable, (1,2) -stable. 916: (1,2) and (2,1) -unstable; 917: $(2k\pi, 0)$ unstable, $((2k+1)\pi, 0)$ stable; 918: $(3, 2)$-unstable, $(0, -1)$ - stable; 919: $(2, 1)$ - stable, $(-2, 1)$ - unstable; 920: $(1, 1)$- unstable, $(-4, -4)$ - stable;921: $(2k\pi, 0)$ - unstable, $((2k+1)\,\pi, 0)$ - stable; 922 $(-1, 2k\pi)$ - stable, $(-1, (2k+1)\pi)$ -unstable.