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\pagebreak\documentclass[12pt,a4paper]{report}
\usepackage[margin=0.5in]{geometry}
\usepackage[utf8]{inputenc}
\usepackage{amsmath}
\usepackage{amsfonts,float}
\usepackage{amssymb}
\usepackage{makeidx,array}
\usepackage{graphicx,graphics,makeidx}
\author{\includegraphics[width=4.9cm]{12}\\
    \\ Submitted by : -\\
    \bf Kalika Prasad\\ klkaprsd@gmail.com
    \\ Enrollment Id : \textbf{2015mstm012}\\\bf M.Sc Tech. Mathematics II-Sem.
    \\\textbf{Mathematical Software Tools(MTM 206) }
    \\\bf {\large  Department of Mathematics}
    \\\bf {\large  Central University of Rajasthan}}
\title{\huge \bf Assignment Solution of WinPP}
\date{}
\begin{document}
    \maketitle
    \pagebreak
    \begin{enumerate}
    \item\textbf{ Define LV-System for population interaction. Using Numerical Simulation techniques,
    demonestrate general properties of the LV-system.
    \subitem (a). Initial Condition dependence
    \subitem (b). Parameter dependence}\\
    \\\textbf{\large Soution :}
    \\ The \textbf{Lotka-Voltra System} ( also known as \textbf{Prey-Predator System}) is a pair of first-order,
    used to describe the dynamics of biological systems. In this system, two species interact, one of as a preda
    time according to the pair of equations:
    \begin{center}
        $\dfrac{dx_1}{dt}= a x_1-b x_1 x_2$
        \\\vspace{.3cm}$\dfrac{dx_2}{dt}= c x_1 x_2-d x_2$
    \end{center}
    where x is number of Prey and y is number of Predator, $\dfrac{dx_1}{dt}$ and $\dfrac{dx_2}{dt}$
    represents the growth rate of two populations over time.
    \\Now, here we see behavior of system when initial conditions and parameter changed one by one.\\
    \\
    \\winPP program for \textbf{LOTAKA-VOLTRA System} : -\\
\\\#LOTAKA-VOLTRA System\\
x1'=a*x1-b*x1*x2\\
x2'=-c*x2+d*x1*x2\\
\\
\#Initial Conditions\\
x1(0)=0.1\\
x2(0)=0.1\\
\\
\#Parameter\\
par a=4.5\\
par b=0.25\\
par c=4\\
par d=0.5\\
\\
\#Numerica Method\\
@ meth=RK,total=50\\
@ bound=1.0e+10\\
done
\pagebreak
\\Now creating table for different value of Initial condition with fixed parameter. Here parameter value are fix
is t=50.\\
\\\textbf{\large I. Initial condition dependence Simulation}
\begin{center}
    $\begin{array}{|c|c|c|c|}
    \hline Serial No. & Initial Condition & x_1 &x_2  \\
    \hline 1  &x_1(0)=0.1, & 8.98148  & 0.305631 \\
    & x_2(0)=0.1 & & \\
    \hline 2  & x_1(0)=0.5, & 34.6436  & 63.5833 \\
    & x_2(0)=0.5 & & \\
    \hline 3  & x_1(0)=0.1, & 0.461034  & 65.1203  \\
    & x_2(0)=0.5  & & \\
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    \hline 4  & x_1(0)=1, & 4.49812  & 0.611741 \\
    & x_2(0)=1 & & \\
    \hline 5  & x_1(0)=1.5, & 0.295818  & 7.36417 \\
    & x_2(0)=1 & & \\
    \hline
    \end{array}$
\end{center}
\textbf{\large II. Graph related to table-I (Limit cycle and Periodic Plots)\\}
\begin{tabular}{|c|c|c|}
    \hline Serial no. & Plot : Limit Cycle. & Periodic Plot \\
    \hline (1) & \includegraphics[width=7.4cm]{LCIC006.jpg} & \includegraphics[width=7.4cm]{PPIC006.jpg} \\
    \hline (2) & \includegraphics[width=7.4cm]{LCIC007.jpg} & \includegraphics[width=7.4cm]{PPIC007.jpg} \\
    \hline (3) & \includegraphics[width=7.4cm]{LCIC008.jpg} & \includegraphics[width=7.4cm]{PPIC008.jpg} \\
    \hline (4) & \includegraphics[width=7.4cm]{LCIC009.jpg} & \includegraphics[width=7.4cm]{PPIC009.jpg} \\
    \hline (5) & \includegraphics[width=7.4cm]{LCIC010.jpg} & \includegraphics[width=7.4cm]{PPIC010.jpg} \\
    \hline
\end{tabular} \\
\\And table for different value of parameter with fixed Initial Condition(value). Here Initial Condition(value o
x_2=0.1 $ and total time is t=50.\\
\\\textbf{\large III. Parameter dependence simulation}
\begin{center}
    $\begin{array}{|c|c|c|c|}
\hline Serial No. & Parameter Value & x_1 &x_2  \\
\hline 1  &a = 4.50 ,c= 4.0, &8.98148 & 0.305631\\
&  b=0.25 , d=0.5& & \\
\hline 2  &a = 4,b= 1& 0.668323 & 0.114302 \\
& c= 4, d= 1  & & \\
\hline 3  &a = 1,b= 1& 1.3783 &0.0241489  \\
& c= 1,d= 1 & & \\
\hline 4  &a = 1,b= 2 & 0.278395 & 0.007859\\
&c= 3,d= 4 & & \\
\hline 5  &a = 4,b= 3 & 1.946777 & 0.0386599\\
& c= 2,d= 1 & & \\
\hline
\end{array}$
\end{center}
\textbf{\large IV. Graph related to table-III (Limit cycle and Periodic Plots)}
\begin{center}
    \begin{tabular}{|c|c|c|}
\hline Serial no. & Plot : Limit Cycle. & Periodic Plot \\
\hline (1) & \includegraphics[width=7.4cm]{LCPC006.jpg} & \includegraphics[width=7.4cm]{PPPC006.jpg} \\
\hline (2) & \includegraphics[width=7.4cm]{LCPC007.jpg} & \includegraphics[width=7.4cm]{PPPC007.jpg} \\
\hline (3) & \includegraphics[width=7.4cm]{LCPC008.jpg} & \includegraphics[width=7.4cm]{PPPC008.jpg} \\
\hline (4) & \includegraphics[width=7.4cm]{LCPC009.jpg} & \includegraphics[width=7.4cm]{PPPC009.jpg} \\
\hline (5) & \includegraphics[width=7.4cm]{LCPC010.jpg} & \includegraphics[width=7.4cm]{PPPC010.jpg} \\
\hline
\end{tabular}
    \end{center}
    \pagebreak[2]
\end{enumerate}
\end{document}
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