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| Indian institute of technology, bombay |
| CL 716 - Modelling Chemical and Biological Patterns |
| Bifurcation analysis of nonlinear reaction-diffusion equations |
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| **30-Mar-15** |

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| The theoretical expressions are limited to the neighborhood of the marginal stability point. Computer simulations allow not only the verification of their predictions but also the investigation of the behavior of the system for larger deviations from the instability point. |

**MATLAB Code**

The Matlab code consists of four files:-

**The main script file**

function pdex4

m = 0;

r = [0 0.005 0.01 0.05 0.1 0.2 0.5 0.7 0.9 0.95 0.99 0.995 1];

t = [0 0.005 0.01 0.05 0.1 0.5 1 1.5 2];

sol = pdepe(m,@pdex4pde,@pdex4ic,@pdex4bc,r,t);

u1 = sol(:,:,1);

u2 = sol(:,:,2);

figure

surf(r,t,u1)

title('X(r,t)')

xlabel('Distance r')

ylabel('Time t')

figure

surf(r,t,u2)

title('Y(r,t)')

xlabel('Distance r')

ylabel('Time t')

**The PDE solver file**

function [c,f,s] = pdex4pde(r,t,u,DuDr)

% Diffusion Coefficients

Dx = 1.6\*10^(-3);

Dy = 8.0\*10^(-3);

% Constants

A = 2;

L = 1;

u1 = u(1);

u2 = u(2);

B = 1; %NOT GIVEN | TO BE CHANGED

c = [1; 1];

f = [Dx; Dy] .\* DuDr;

s1 = A + u1^2\*u2 - (B+1);

s2 = B\*u1 - u1^2\*u2;

s = [s1; s2];

**Boundary condition definition file**

Note: Two types of boundary conditions will be considered:-

1. Zero Flux Boundary Conditions (Neumann conditions)
2. Fixed Boundary Conditions (Dirichlet conditions)

function [pl,ql,pr,qr] = pdex4bc(rl,ul,rr,ur,t)

% Constants

A = 2;

B = 1; %NOT GIVEN | TO BE CHANGED

% Case 1:- Zero Flux Boundary Conditions (Neumann conditions)

% pl = [0; 0];

% ql = [1; 1];

% pr = [0; 0];

% qr = [1; 1];

% Case 2:- Fixed Boundary Conditions (Dirichlet conditions)

pl = [A; B/A];

ql = [0; 0];

pr = [A; B/A];

qr = [0; 0];

**Boundary condition definition file**

function u0 = pdex4ic(r);

u0 = [1; 1];

The sole purpose to define four separate files is to keep the distinguished structure.