# Department of Applied Mechanics
## Major Examination
## (Computational Mechanics AML-310)

Question:-1 How an efficient parallel computing will be achieved if F.E. Equation, $F = K\delta$ involves a large ndf, solved iteratively a number of times. Give a flow diagram explicitly showing the main features namely, parallel environment, processing system, programming technique, load balancing, perfect speed up, programming paradigm, performance study, speed up and effcicency.

Question:-2 To solve a system of following equations of size ndf $[M][\ddot{x}]+[C][\dot{x}]+[K][x]=[F(t)]$, Give an algorithm of $4^{th}$ order R.K. Method starting from t=0 to t=100 sec, $\Delta t = 0.2\,\text{sec}$. Ensure stability and accuracy.

Question:-3 Illustrate the complete loop of computation to solve the following non-linear system of equations used to model a mechanical system.

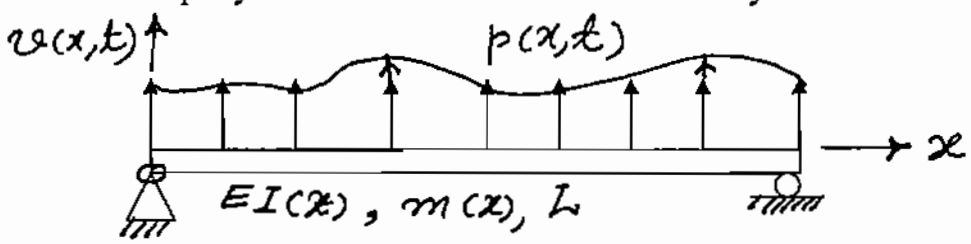
$$2\left(\frac{d^2x}{dt^2}\right)^2 = -15\left(\frac{dx}{dt}+\frac{dy}{dt}\right)\frac{dx}{dt}$$

$$5\left(\frac{d^2y}{dt^2}\right)^2 = +12\left(\frac{dx}{dt}+\frac{dy}{dt}\right)\frac{dy}{dt}$$

As per the initial conditions t=0, x=0, y=0

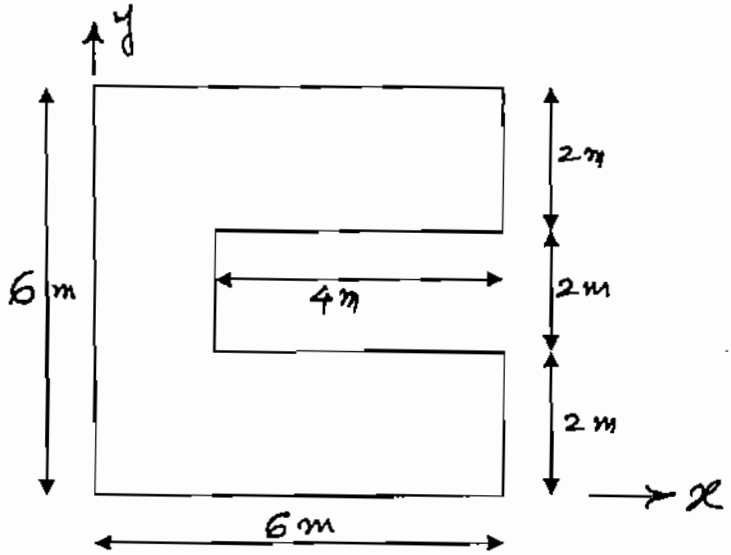
$\dot{x}=1,\ \dot{y}=1$

Question:-4 A flexural component of a railway coach modeled as a S.S. beam as shown under a distributed dynamic load **p(x,t)** obtain the governing equation showing the equilibrium between inertia, restoring and external forces. What numerical technique you recommend to solve it and why?



Question:-5 Fluid is flowing through a conduit having a cross section as shown. The partial differential equation for the steady state velocity $\phi$ of the fluid is

$\frac{\partial^2\phi}{\partial x^2}+\frac{\partial^2\phi}{\partial y^2}=\frac{-c}{\mu}$ Where **c** is the absolute velocity of pressure gradient in the direction of flow and $\mu$ is the viscosity of the fluid. Nothing that the velocity of the fluid is zero on the boundaries, write an algorithm for obtaining the velocity distribution of the fluid.




The values of **c** and $\mu$ are as follows

$c = 0.02 units$ (Constant over the cross section)

$\mu = 0.25\times10^{-6} units$

Question:-6 Give brief accounts of the following:-

a. Direct numerical integration of a differential equation to model the elastic curve of a cantilever beam with uniform cross section.

b. Five major sources of errors in computational methods and their rectification.

c. Partial differential equations to model a laminar boundary layer on a horizontal flat plate for 2-Dimensional, steady, incompressible flow with zero pressure gradient.