Mansoura University
Faculty of Engineering
Mech. Power Eng. Dept.

2nd year Production Eng.
Final Exam., jun 2009
Time: 3 Hrs

Computer application

Attempt all questions, assume any missing data

Question No. 1:

1) Sketch the block diagram of the structure of typical programmable logic controller and define the scan time
2) Sketch the CNC machine control and define the job for each part
3) Write the following expression for the statement in CNC program
   A) N5 G92 X-1.000 Y1.000 Z1.000
   B) N40 X1.625 Y-.375
   C)N10 G00 X1.25 Z.100
   d) N5 G92 X-1.000 Y2.000 Z1.000
   f) N5 G92 X-2.000 Y1.000 Z1.000
   g) N10 G92 X-1.000 Y1.000 Z1.000
   h) N5 G92 X4.000 Y1.000 Z1.000

4) Sketch the CNC schematic diagram
5) Sketch the CNC machine block diagram

Question No. 2: take the error less than 0.01

1) Solve and sketch the flow chart of solution of equation

$$\frac{\partial^2 \phi}{\partial X^2} + \frac{\partial^2 \phi}{\partial Y^2} = 1.5$$

in the body with dimension in horizontal direction 10 cm and in vertical direction 5 cm take the boundary condition at x=0, $0 \le Y \le 5$ $\Phi=1$ and at X=10 cm $0 \le Y \le 5$, $\Phi=1.5$ at y=0, $0 \le X \le 10$ $\Phi=1$ and at Y=5 cm $0 \le X \le 10$, $\Phi=0.5$

2) Solve and sketch the flow chart of solution of equation

$$\frac{\partial \phi}{\partial t} = \frac{1}{\alpha}\left(\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2}\right)$$

body with dimension in horizontal direction 10 cm and in vertical direction 5 cm take the initial condition at t=0.0 x=0, $0 \le Y \le 5$ $\Phi=0$ and at X=10 cm $0 \le Y \le 5$, $\Phi=0.5$ at y=0, $0 \le X \le 10$ $\Phi=0.2$ and at Y=5 cm $0 \le X \le 10$, $\Phi=0.1$
take $\Delta t=0.1$ and solve at $0.3\ \Delta t$

Question No. 3:

1) make the step for solve the model
a) The Denavit-Hartenberg Parameters in Robotics

b) Full Rigid-Body Motion Composition of Motion
2) Consider a in Robotics
PUMA 560 manipulator with

P.T.O.

$$ {}^{0}_{6}T_{des} = \begin{bmatrix} -\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} & 1 \\ 0 & -1 & 0 & 1 \\ \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} & -1 \\ 0 & 0 & 0 & 0 \end{bmatrix} $$

And assume the Denavit-Hartenberg parameters are as listed in the table 1 assume $a_1=0$, so find θ_3

Table (1) PUMA 560 Denavit –Hartenberg Parameters

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	0	θ_1
2	-90	0	0	θ_2
3	0	3	1.1	θ_3
4	-90	0..5	3	θ_4
5	90	0	0	θ_5
6	90	0	0	θ_6

Using the following function to solve above problem

$$f_1(\theta_3) = a_2 \cos\theta_3 + d_4 \sin\alpha_3 \sin\theta_3 + a_2$$

$$f_2(\theta_3) = a_3 \cos\alpha_2 \sin\theta_3 - d_4 \cos\alpha_2 \sin\alpha_3 \cos\theta_3 - d_4 \cos\alpha_3 \sin\alpha_2 - d_3 \sin\alpha_2$$

$$f_3(\theta_3) = a_3 \sin\alpha_2 \sin\theta_3 - d_4 \sin\alpha_2 \sin\alpha_3 \cos\theta_3 + d_4 \cos\alpha_3 \cos\alpha_2 + d_3 \cos\alpha_2$$

3) **make the step for solve the model using** Newton's methods

Good luck