F21RO INTELLIGENT ROBOTICS TUTORIAL 1 VAL

QUESTION 1.

Examine the following VAL-1 program:

```
SHIFT NIB BY 10.0, 10.0, 0.0
MOVE NIB : OFFSET
MOVES NIB
SHIFT NIB BY 80.0, 80.0, 0.0
MOVES NIB
SHIFT NIB BY 80.0, -80.0, 0.0
MOVES NIB
DEPART 20
SHIFT NIB BY -40.0, 40.0, 0.0
MOVE NIB : OFFSET
MOVES NIB
SHIFT NIB BY -80.0, 0.0, 0.0
MOVES NIB
DEPART 20
SHIFT NIB BY -50.0, -50.0, 0.0
MOVES NIB
STOP
```

If a pen is used as the end-effector of a PUMA robot executing this program and a blank piece of paper is supported in the Z=0 plane and *NIB* and *OFFSET* are initialised as follows:

$$NIB = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad OFFSET = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 20 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

i). Draw a diagram of the shape which will appear on the paper. Give precise co-ordinates for all important points and indicate the direction of travel of the Tool Centre Point.

ii). What would be the likely effects of substituting *MOVE* commands for *MOVES* commands in the program?

iii). Why is the off-line programming of robots in this manner still problematic and unreliable?

QUESTION 2.

Describe three other methods by which an industrial manipulator could be programmed.