3 Computer Graphics and Image Processing (PR)

A program is required to draw an arc from $(0, 1)$ to $(1, 0)$ of the circle centred at the origin with unit radius.

(*a*) One approach would be to draw a segment of the cubic Overhauser curve defined by $(-1, 0)$, $(0, 1)$, $(1, 0)$ and $(0, -1)$.

(*i*) Explain how a segment of an Overhauser curve in general can be represented as an Hermite cubic and so as a Bézier cubic. [4 marks]

(*ii*) Derive the formula for the resulting Bézier curve, $\mathbf{P}(t)$. [3 marks]

(*iii*) Calculate the coordinates of $\mathbf{P}(\frac{1}{2})$. How large is the error? [*Hint*: $\sqrt{2} \approx 1.414$.] [3 marks]

(*b*) Calculate revised control points for the Bézier curve so that it models the circular arc more accurately. [4 marks]

(*c*) Describe in outline an alternative way of efficiently drawing the arc by calculating the pixels that lie on it directly. [6 marks]