Q3) Consider the function in Q2:

$$f(x) = x^2 + 4\cos x$$

Use Golden_section search ($x_l = 1$, $x_u = 3$, $\epsilon_s = 1\%$) to find the minimum of $f(x)$.

Solution:

HINT $\begin{cases} \text{Min } f(x) = \text{Max } -f(x) \\ \text{Let } g(x) = -f(x) \Rightarrow g(x) = -x^2 - 4\cos x \end{cases}$

we use $-f(x)$ here as $f(x)$

$x_l = 1$, $x_u = 3$, $d = \frac{\sqrt{5}-1}{2}(x_u - x_l) = 1.236$

$\Rightarrow x_1 = x_l + d = 2.236$, $x_2 = x_u \mp d = 1.764$

$\Rightarrow f(x_1) = -2.5308$ and $f(x_2) = -2.3437$

since $f(x_2) > f(x_1) \Rightarrow x_u = x_1 = 2.236$, $x_l = x_l$ $\Rightarrow x_1 = x_l + d = 1.7638$, $x_2 = x_u - d$

$x_2 = 1.4722$

$d = r(x_u - x_l)$

$\Rightarrow \epsilon = \left|\frac{x_{old} - x_{new}}{x_{new}}\right| \times 100\% = 0.5528$

$\Rightarrow f(x_1) = -2.3437$, $f(x_2) = -2.5612$

Since $f(x_1) > f(x_2) \Rightarrow x_l = x_2 = 1.4722$, $x_u = x_u \Rightarrow d = 0.4721$

$\Rightarrow x_1 = x_l + d = 1.9442$, $x_2 = x_u - d = 1.7639$, $\epsilon = 0.5189$

$\Rightarrow f(x_1) = -2.3208$ $f(x_2) = -2.3437$

sinc..... Iteration 9: $\epsilon = 0.0138$, Iteration 10, $\epsilon = 0.0086$

, $x_1 = 1.8955$, $x_2 = 1.8915$