Problem 3:

a)   Cell-Centered flux:

Graph at Mesh Spacing 0.080000

Graph at Mesh Spacing 0.100000

Graph at Mesh Spacing 0.125000

Graph at Mesh Spacing 0.200000

Graph at Mesh Spacing 0.400000
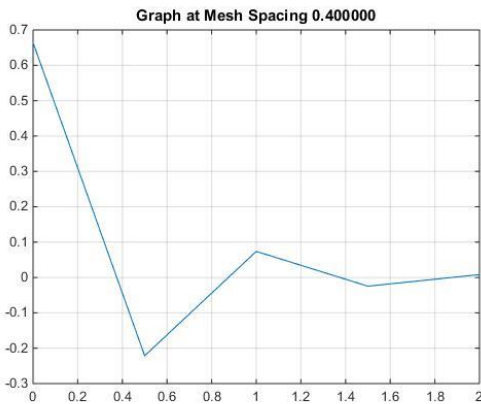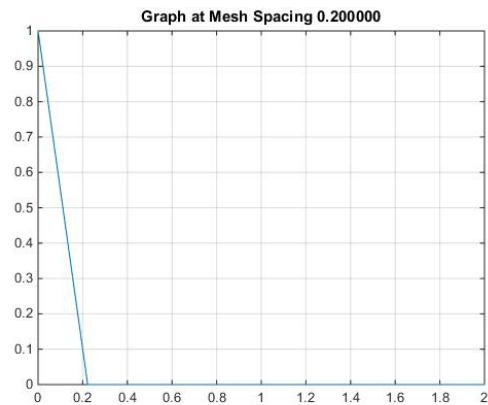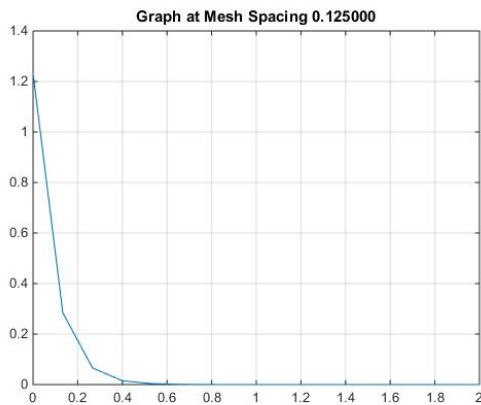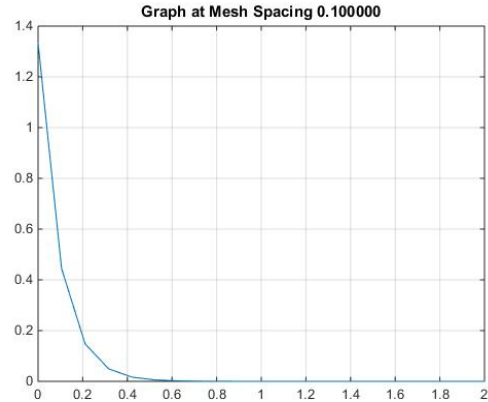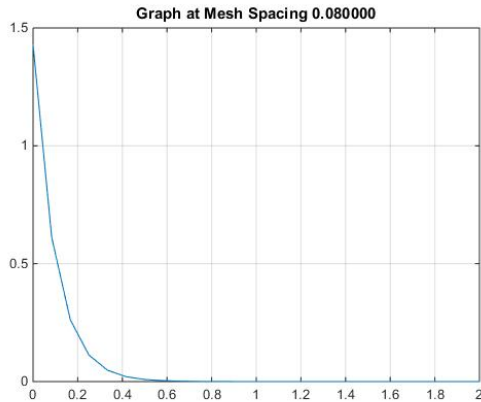
In this case, $\alpha = 0$ for all graphs. When $\Delta_i = 0.4$ we observe negative flux. This is the case as requirement stated in problem 2; mesh spacing (Δ_i) $< 2\mu/\Sigma_t$ doesn't hold true ($0.4 < 0.2$).

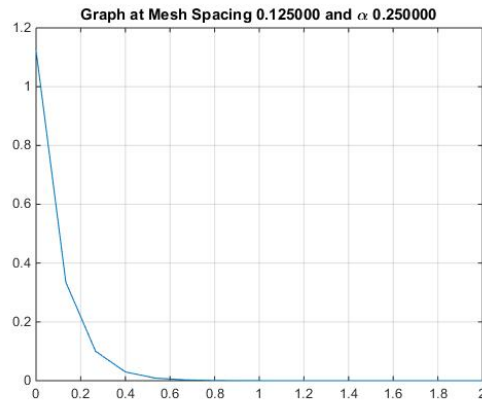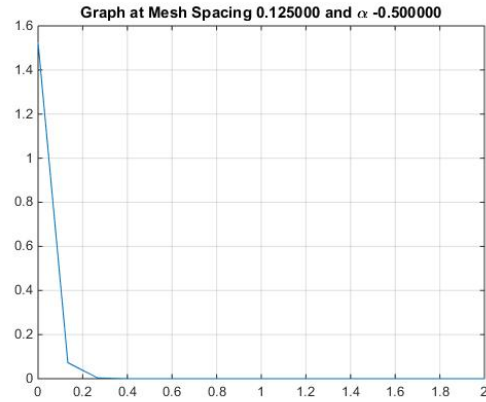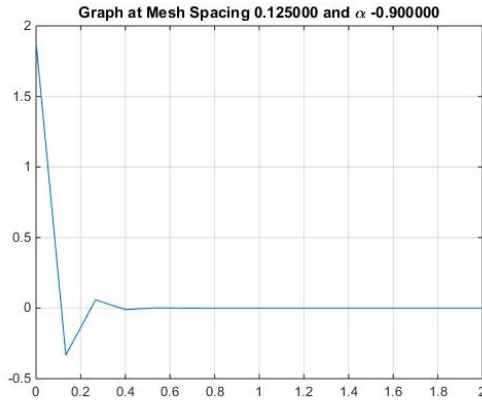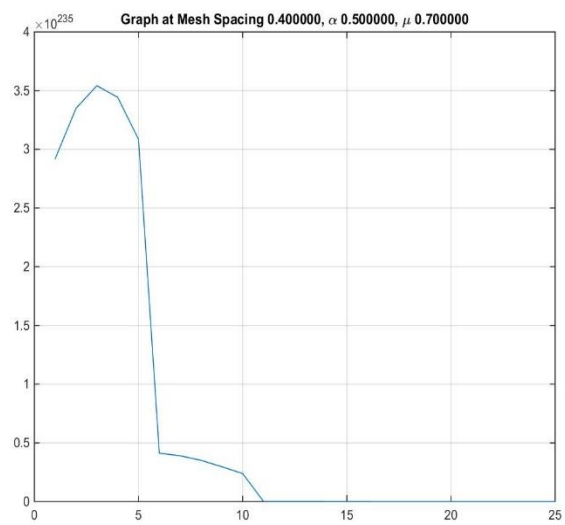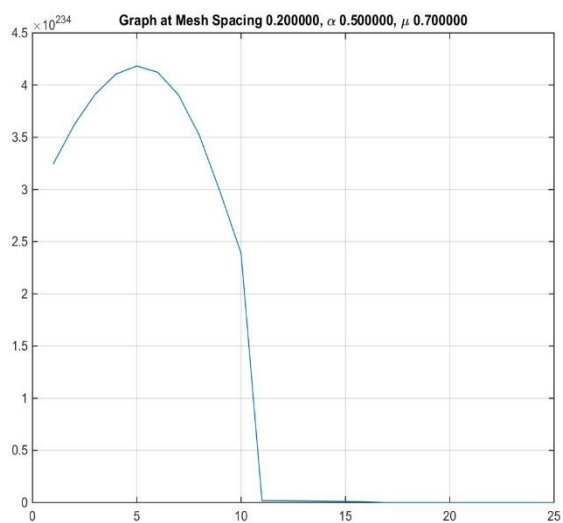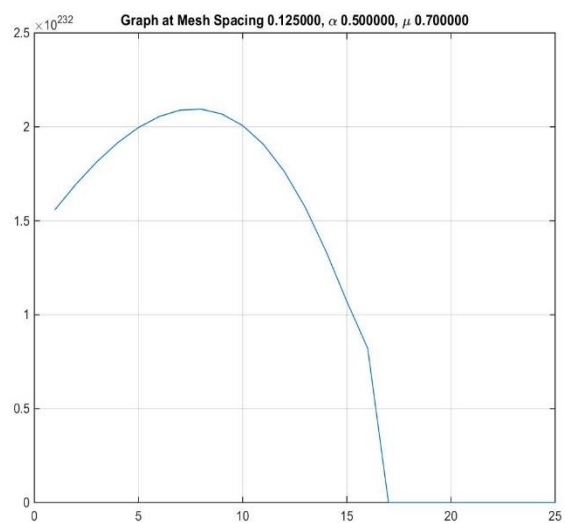b)   Impact of α when $\alpha = [-0.9, -0.5, 0.25, 0.5, 0.9]$.
Let's look at different α's at $\Delta_i = 0.125$. Graphs at other Δ_i are present in the folder.

Graph at Mesh Spacing 0.125000 and α -0.900000

Graph at Mesh Spacing 0.125000 and α -0.500000

Graph at Mesh Spacing 0.125000 and α 0.250000

Graph at Mesh Spacing 0.125000 and α 0.500000

Graph at Mesh Spacing 0.125000 and α 0.900000
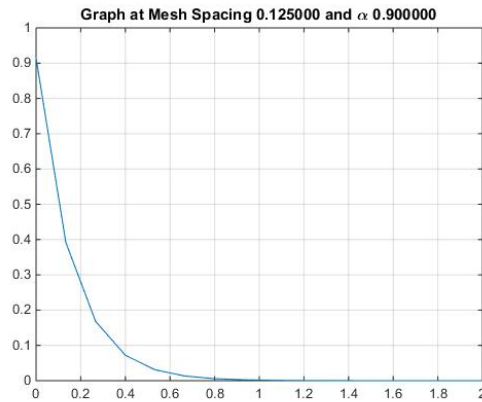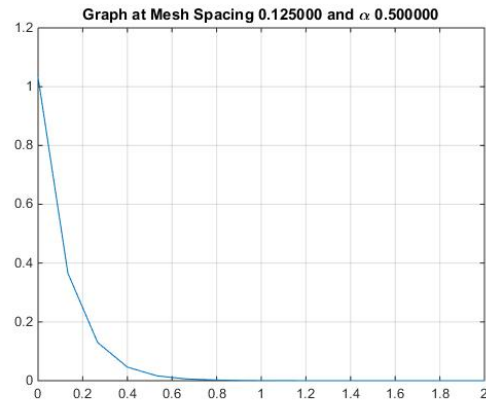
When α term is introduced, the requirement stated in problem 2 is changed by factor of $1+\alpha$ in this case because of going $x = 0$ to $x = 2$. $\Delta_i*(1+\alpha) < 2\mu/\Sigma_t$ should hold true to prevent negative flux.

c)   Adding source:
Graphs at $\mu = 0.7$, $\alpha = 0.5$, and for all mesh spaces here. Other graphs are in the folder.

Graph at Mesh Spacing 0.080000, α 0.500000, μ 0.700000

Graph at Mesh Spacing 0.100000, α 0.500000, μ 0.700000

Graph at Mesh Spacing 0.125000, α 0.500000, μ 0.700000

Graph at Mesh Spacing 0.200000, α 0.500000, μ 0.700000

Graph at Mesh Spacing 0.400000, α 0.500000, μ 0.700000
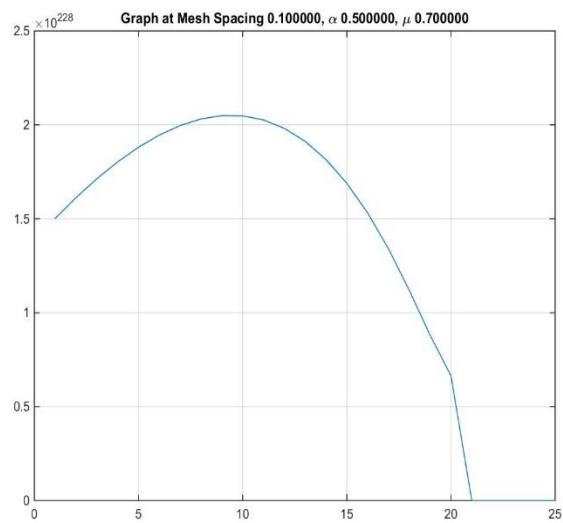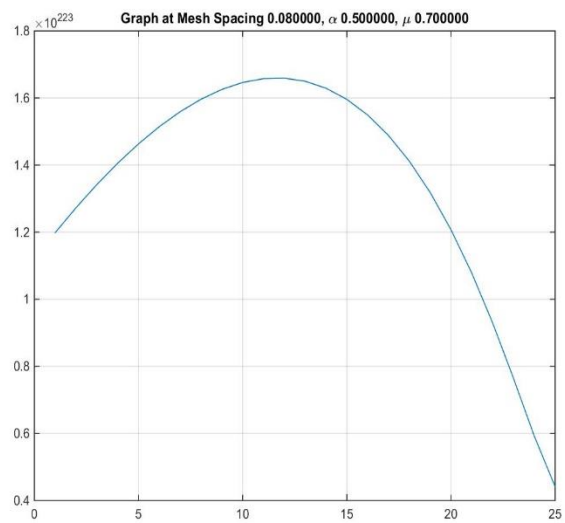
d) $\alpha = 0$, $\Sigma_s = 0.9$:

As we increases Σ_s, the scalar flux increase and there is point of inflection on the graphs.