PROBLEM STATEMENT

Program a coupled trim solution for the helicopter for which the data is given below. All integrations are to be performed numerically using six-point Gaussian Quadrature.
In the numerical integration, the blade must first be discretized into a series of small elements (10 to 20) of equal span. Flap response equation must be solved numerically using Newmark's algorithm. Use uniform inflow. In the current assignment would do up to the solution of blade flap dynamics.
Relevant data pertaining to UH-60A Black Hawk helicopter are given below:

Density of air, ρ	1.225 $\mathrm{kg/m^3}$
Number of blades, N_b	4
Blade radius, R	8.18 m
Blade chord, C	0.46 m
Profile Drag coefficient, C_{do}	0.01
Lift curve slope, C_{l_α}	5.73
Rotor angular speed, Ω	27 π rad/sec
Blade flap frequency, ν_β	1.04 per rev
Lock number, γ	8.0
Weight of the aircraft	70000 N
Blade twist rate, θ_{tw}	0°

Do the following:

Q1. For the following inputs, using Gaussian-Quadrature numerical integration, evaluate and plot aerodynamic flap moment ($M\beta$) as a function of azimuth ψ and compare it by plotting on the same graph the exact expressions given in class. Assume following values: μ = 0.2857, λ = 0.02284, $\theta 0$ = 8.2◦, $\theta 1c$ = 3.3◦, $\theta 1s$ = -11.2◦, $\beta 0$= 4.84◦, $\beta 1c$ = 6.38◦, $\beta 1s$ =.91◦, αs = -4.1◦ and ϕs= -3.84◦. Comment on the plot(s).

Q2. Using the implementation for $M\beta$ estimation from above, and the same inputs as Q1, starting with zero initial conditions solve the flap equation using Newmark's algorithm (use parameters as given in class) and plot the periodic solution of flap for one revolution vs ψ and compare it with exact solution obtained in class using harmonic balance method.
Also show the plot for the entire time history for flap. Note: Since you are solving for β, you cannot use harmonics of β given in Q1. Study the effect of changing the effect of time step by varying it for following values: 15◦, 10◦, 5◦, 3◦ and 2◦.