$$K_0(r, \xi_m) = J_0(\xi_m r)\left(\quad Y_0(\xi_m b)\right)$$

$$- Y_0(\xi_m r)\left(\quad J_0(\xi_m b)\right)$$

$$K_1(r, \eta_n) = J_1(\eta_n r)\left(\quad Y_1(\eta_n b)\right)$$

$$- Y_1(\eta_n r)\left(\quad J_1(\eta_n b)\right)$$

$$U_1 = -\frac{\int_a^b rK_0(r,\xi_m)\left\{\frac{\partial K_1(r,\eta_n)}{\partial r} + \frac{K_1(r,\eta_n)}{r}\right\}dr}{\int_a^b r\,[K_0(r,\xi_m)]^2\,dr}$$

$$U_2 = -\frac{\int_a^b rK_1(r,\eta_n)\frac{\partial K_0(r,\xi_m)}{\partial r}dr}{\int_a^b r\,[K_1(r,\eta_n)]^2\,dr}$$

$$U_3 = \frac{\int_a^b r^2\omega^2 K_1(r,\eta_n)dr}{\int_a^b r\,[K_1(r,\eta_n)]^2\,dr}$$

$$\frac{d^3S_{mn}}{dt^3} + \xi_m^2\frac{d^2S_{mn}}{dt^2} + \left(\eta_n^2 - U_2U_1\right)\frac{dS_{mn}}{dt} + \xi_m^2\eta_n^2S_{mn} = U_2U_1a_n\dot{\bar{u}}_1 + U_2b_mA_1(t) + \xi_m^2U_3$$

$$\frac{d^3Q_{mn}}{dt^3} + \xi_m^2\frac{d^2Q_{mn}}{dt^2} + \left(\eta_n^2 - U_1U_2\right)\frac{dQ_{mn}}{dt} + \eta_n^2\xi_m^2Q_{mn} = U_1U_2b_m\dot{\bar{T}}_1 + U_1a_n\dot{A}_2(t)$$

Above Eqs are a nonhomogeneous ordinary differential equation with
constant coefficients and have general and particular solutions.

The characteristic equation corresponding to either of Eq.

$$s^3 + \xi_m^2 s^2 + \left(\eta_n^2 - U_2 U_1\right) s + \xi_m^2 \eta_n^2 = 0$$

For each m and n, above Eq. has three roots where one is real and negative and two other ones are complex conjugate with a negative real part.