Figures (19)-(24) show the frequency response curves for the superharmonic resonance. From the geometry of the Figures we note that, each of these modes has one continuous curve reach its maximum value for small value of δ_3 and the solutions have stable and unstable solutions. For simultaneously decreasing the coefficients of external excitations F_1, F_2 and F_3 respectively, a_1 has decreasing magnitudes and the region of stability is decreased, Figs.(19-21). When the detuning parameter δ_1 increased, the point of maximum values of a_2 and a_3 are transformed and its unstable, Fig.(22). By decreasing the detuning parameters δ_1 and δ_2, the region of stability is increased, Fig.(23). When the coefficients of damping terms μ_1, μ_2 and μ_3 are increasing simultaneously, the three modes have decreasing magnitudes and the regions of stability is decreased, Fig.(24).

5.9- SUMMARY AND CONCLUSION

We study the response of three-degrees-of-freedom system with quadratic nonlinearities to a harmonic excitation in the presence of autoparametric resonances $\omega_2 \cong 2\omega_1$ and $\omega_3 \cong 2\omega_2$, where ω_n (n=1,2,3) are the linear natural frequencies of the system. The method of multiple scales is used to construct a first-order non-linear ordinary differential (average) equations governing the modulation of the amplitudes and phases of the three modes, these equations are used to determine steady state solutions. Numerical calculations are presented which illustrate the behavior of the steady state response amplitudes as a function of the detuning parameter. Stability analysis is carried out for each case of resonance.

From the geometry of the Figures, we note that

- From the theoretical analysis we observe that, from the first approximation when the amplitudes of external forces are of order ε, there exist only primary resonance and when the amplitudes of external forces are of order one, there exist many types of resonances for examples, primary resonance, sub-harmonic resonance and super-harmonic resonance.
- Each mode has maximum and minimum values.
- From these cases we observe that, for each values of δ_3 there exist one value of a_1, a_2 and a_3.
- From these cases we observe that, the third mode has small magnitudes by comparing with the magnitudes of the first and second modes.
- When the amplitudes of external forces are of order one for the cases of primary resonance and sub-harmonic resonance we observe that, all solutions are unstable.
- When the amplitudes of external forces are of order ε, we observe that the region of stability is discontinues for δ =1.9.