The results relating to simultaneous determination of Cd(II) and Co(II) are presented in this section.

Figures 4.4.1 and 4.4.2 represent the zero order spectra of Cd(II) and Co(II) in a solution of pH 9.0. The λ\text{max} for these two systems are 355.4 and 364.5 nm respectively. The zero order spectrum of the solution containing both the metal ions is also recorded and presented in figures 4.4.3. It is seen from this figure that the solution containing the mixture of metal ions shows only one peak at 357.6 nm. Hence it is not possible to determine Cd(II) and Co(II) simultaneously by employing zero order spectrum. Attempts are made by the author to use the first order derivative spectrophotometric method for the simultaneous determination. The results are not favorable especially when high concentrations of metal ions are used. The author has therefore adapted second order spectrophotometry for simultaneous determination of these two ions.

A series of solutions are prepared containing varying concentrations of Cd(II) and Co(II). An excess of reagent i.e. 25 fold concentration is taken to complex with both the metal ions. The solution is made up to the mark by adding a buffer solution of pH 9.0 in a 25 ml volumetric flask.

A blank solution is prepared on the same lines as in earlier systems.

The second order spectrum recorded for experimental solution against the respective blank is presented in figure 4.4.5. An examination of the figure reveals that there are two peaks corresponding to the two metal ions. The peak at 370.4 nm corresponds to Cd(II) and the one at 387.4 nm corresponds to Co(II). The author has
recorded individual second order spectra for Cd(II) and Co(II). The peak values are determined in each case. The peak at 370.4 nm and the valley at 377.4 nm correspond to Cd(II). Similarly the peak at 387 nm and the valley at 402.8 nm correspond to Co(II).

The peaks for the two metals differ by more than 15 nm and also the valleys. Hence, the second order derivative spectrum can be used for the simultaneous determination of Cd(II) and Co(II). Typical second order derivative spectrum is shown in figure 4.4.4.

**Simultaneous determination of Cd(II) and Co(II)-present method**

In the present method, concentration of both the metal ions are varied keeping the reagent concentration constant. Blank solutions are also prepared on the same lines, but without containing the metal ions. For each of the solution the second order derivative spectrum is recorded. These are shown in figures 4.4.5. Graphs are plotted between the concentration of Cd(II) and Co(II). Linear plots are obtained in the case of Cd(II) and Co(II) when graphs are plotted between concentration and peak amplitude or valley amplitude, sum of peak and valley amplitudes.

It may be mentioned here that straight line plots are obtained even with the sum of peak and valley amplitudes. These linear plots are shown in figs. 4.4.7 and 4.4.6 for Cd(II) and Co(II) separately.

Thus the second order derivative spectrophotometric method is very useful to make simultaneous determination of Cd(II) and Co(II) in microgram quantities. Using the sum of peak and valley amplitudes it is possible to achieve greater sensitivities. The simultaneous determination can be carried out for mixtures containing both the metal ions and separation is not necessary. This derivative
method can be used for the analysis of alloys or simulated mixtures containing both the metal ions.
Fig: 4.4.1  Zero order spectrum of Cd (II) in presence of FFTSC
[ Cd (II) ] = 2.4 x 10^{-5} M ; [ FFTSC ] = 5.2 x 10^{-4} M ; pH = 9.0

Fig: 4.4.2  Zero order spectrum of Co (II) in presence of FFTSC
[ Co (II) ] = 1.6 x 10^{-5} M ; [ FFTSC ] = 5.2 x 10^{-4} M ; pH = 9.0
Fig: 4.4.3  Zero order spectrum of Cd (II) + Co (II) in presence of FFTSC
[Cd (II)] = 2.4 x 10^{-5} M ; [Co (II) = 1.6 x 10^{-5} M
[FFTSC] = 5.2 x 10^{-4} M
pH = 9.0

Fig: 4.4.4  Typical second order spectrum of Cd (II) + Co (II) in presence of FFTSC
[Cd (II)] = 2.4 x 10^{-5} M ; [Co (II) = 1.6 x 10^{-5} M
[FFTSC] = 5.2 x 10^{-4} M
pH = 9.0
Fig: 4.4.5  Second order spectrum of Cd (II) + Co (II) in presence of FFTSC

\[ [\text{Cd (II)}] = 2.4 \times 10^{-5} \text{M} ;
\[ [\text{Co (II)}] = 1.6 \times 10^{-5} \text{M}

\[ [\text{FFTSC}] = 5.2 \times 10^{-4} \text{M}

\text{pH} = 9.0

a) 0.5 ml of Cd(II) and Co(II) each
b) 1.0 ml
   "
c) 1.5 ml
   "
d) 2.0 ml
   "
e) 2.5 ml
   "
f) 3.0 ml
   "

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Fig: 4.4.6  Second derivative amplitude Vs Concentration of Cd (II)
          a = Peak ; b = Valley ; c = Peak + Valley

Fig: 4.4.7  Second derivative amplitude Vs Concentration of Co (II)
          a = Peak ; b = Valley ; c = Peak + Valley