List of figures

Figure 2.1	: Phases of H_{α} profile	7
Figure 2.2	: H_{α} excess as a function of envelope size (a/a*)	9
Figure 2.3	: Orbital plane of each streamline inclined with respect to the equatorial plane by the initial latitude of streamline	13
Figure 2.4	: Schematic diagram for MTD model (Cassinelli etal., 2002)	15
Figure 2.5	: Correlation of massloss rate and luminosity of the stars	17
Figure 2.6	: Schematic diagram of rotational velocity of a star rotating at inclination angle i	19
Figure 2.7	: Variation of line profile can be explained by the one-armed oscillation disc model	23
Figure 2.8	: The <i>E/C</i> variation of H_{α} in μ Cen from May 1973 to May 1976	24
Figure 3.1	: Binary orbit of δ -Sco system for periastron in 2000	29
Figure 4.1	: Normalisation process	32
Figure 4.2	: Synthetic telluric line spectrum in the range of $H_{\boldsymbol{\alpha}}$	33
Figure 4.3	: Telluric line correction	34
Figure 4.4	: Definition of equivalent width and full width at half maximum	38
Figure 4.5	: Distribution functions of Gaussian, Voigt and Lorentzian	39
Figure 4.6	: Measurement of FWHM on a close separation double peak	40
Figure 4.7	: Measurement of FWHM on a well separated double peak	40
Figure 5.1	: Line identification in optical region of δ -Sco	45
Figure 5.2	: Profiles of Balmer lines of δ -Sco in comparison to relative normalised intensity	48
Figure 5.3	: Blended absorption lines (a) and the double-peaked emission lines (b)	49
Figure 5.4	: Features of double-peak emission line	51
Figure 5.5a	: Several typical H_{α} line profiles observed in 2007 and 2008	58

Figure 5.5b	: Red asymmetric H_{α} line profiles observed in 2009	59
Figure 5.5c	: Violet asymmetric H_{α} line profiles in 2010	60
Figure 5.6	: Correlations of <i>FWHM</i> with relative disc radii (top) and <i>EW</i> with relative disc radii of H_{α} emitting region shown by the green line	62
Figure 5.7	: Behaviour of parameters in the H_{α} emitting region from 2007 to 2010	63
Figure 5.8	: Evolution with time of H_{α} line profile variation from 2007 to 2010	64
Figure 5.9	: <i>V/R</i> variation of H_{α} from 2007 to 2010	65
Figure 5.10	: <i>V/R</i> ratio of H_{α} , H_{β} and H_{γ} of δ -Sco from 2007 to 2010	66
Figure 5.11	: Correlation of <i>V/R</i> and the relative disc radius of H_{β} and H_{γ} (above) and H_{α} emitting regions (below) from 2009 to 2010	68
Figure 5.12	: Evolution of H_{α} , H_{β} and H_{γ} lines profile in 2010	70
Figure 5.13a	: Variation of line strength and relative disc radii with time of H_{β} (top panel) and H_{γ} (lower panel)	71
Figure 5.13b	: Correlation and evolution of the relative disc radii and V/R ratio of Balmer lines	72
Figure 5.13c	: Correlation of the radial velocity (<i>RVcr</i>) and <i>V/R</i> ratio with time in H_{α} , H_{β} and H_{γ}	73
Figure 5.14	: Correlation of radial velocity (<i>RV</i>) and <i>V/R</i> variations with time (top) and the variation of <i>EW</i> of <i>HeI</i> λ 6678 with time from 2007 to 2010 (bottom)	79
Figure 5.15	: Evolution of triple-peak profile of HeI λ 6678	80
Figure 5.16(a): Triple- or multiple-peaked and anomalous profiles of <i>HeI</i> in 2007 (panel I) and 2008 (panel II)	81
Figure 5.16(b): The variety of features of <i>HeI</i> λ 6678 line profile in 2009 (panel III) and 2010 (panel IV)	82
Figure 5.17	 (a) The P-Cygni profile, (b) The 'shoulder' structure, (c) The classic P-Cygni profile 	82
Figure 5.18	: Correlation between equivalent width of H_{α} and HeI $\lambda 6678$	83
Figure 5.19	: Strength variation of H_{α} and <i>HeI</i> λ 6678 emission lines with time	84

Figure 5.20a	:	Correlation of disc radii and line strength: <i>HeI</i> λ 6678(top) and H _a (bottom)	84
Figure 5.20b	:	Correlation of the line strength and disc radii: <i>HeI</i> λ 6678 (top) and H _a (bottom)	85
Figure 5.21	:	Variation of the disc radii and V/R of <i>HeI</i> λ 6678 emitting region throughout the observation period from 2007 to 2010	86
Figure 5.22	:	Dashed lines show peak separation of H_{α},H_{β} and HeI $\lambda6678$	87
Figure 5.23	:	Variation of the disc radii of <i>HeI</i> λ 6678 emitting region throughout the observation period from 2007 to 2010	87
Figure 5.24	:	Dashed lines denote the estimation of <i>FWHM</i> on some of the photospheric lines	88
Figure 5.25	:	Profiles of photospheric lines in the blue region of δ -Sco spectra from 2008 to 2010 observing runs	91
Figure 5.26	:	Variations of <i>EW</i> (a) and <i>FWHM</i> (b) of <i>HeI</i> λ 4388, 4921, <i>MgII</i> λ 4481, and <i>HeII</i> λ 4686 from 2008 to 2010	92
Figure 5.27	:	Correlation of <i>FWHM</i> and <i>EW</i> of <i>HeI</i> λ 4388, 4471, 4921, <i>MgII</i> λ 4481, and <i>HeII</i> λ 4686	92
Figure 5.28	:	Variation of the line strength in the circumstellar envelope	93
Figure 5.29	:	Variation of equivalent width of the outer and inner envelope	95
Figure 5.30	:	Relative intensity of H_{α} in 2010 and 2011	96
Figure 5.31	:	The <i>HeI</i> λ 6678 profile during the periastron passage	97
Figure 5.32	:	V/R variation of the lines from the emitting regions of $H_{\alpha},H_{\beta},H_{\gamma}$ and HeI $\lambda6678$	98
Figure 5.33	:	Radial velocity of <i>HeII</i> λ 4686 and H _{α} lines	99
Figure 5.34	:	Evolution of H_{α} line profile variation with time for 2011 starting from March to July	101
Figure 5.35	:	Variation of H_{α} line profile in the last periastron passage which occurred between 7 th to 12 th September 2000	102
Figure 5.36	:	Correlation of <i>EW</i> and Rd/R^* of H _β (top) and correlation between V/R and Rd/R^* (below) when closing to the periastron passage	103
Figure 5.37	:	Variation of <i>FWHM</i> , <i>RV</i> and <i>EW</i> values of <i>HeII</i> λ 4686 during the recent periastron passage in early July 2011	106
Figure 6.1	:	The correlation of <i>BC</i> and the log T_{eff} (Flower, 1996)	117

Figure 6.2	:	Models of evolutionary track of δ -Sco at 345, 300 and 270 km/s initial rotation velocities	121
Figure 6.3	:	Models of main sequence phase of δ -Sco at different initial rotational velocities for Z = 0.01 and 0.02 with estimated current status	122
Figure 6.4	:	Ratio of rotational velocity to the critical velocity varies with time from ZAMS to the red giant branch	125
Figure 6.5	:	Model evolutions of V_{rot} with rotation rate at different initial Vrot for Z = 0.01 with initial mass of 12.5 M \odot	126
Figure 7.1	:	Schematic diagram of the concept of emission and absorption lines in Be star	129
Figure 7.2	:	Variations of H_{α} line profiles from 2007 to 2011	131
Figure 7.3	:	Evolution of H_{α} line profile from 2007 to 2010	132
Figure 7.4	:	Graphs of the line profiles variations of H_β from 2008 to 2011	134
Figure 7.5	:	Variation of <i>EW</i> and <i>FWHM</i> of H_{β} from 2008 to 2011	135
Figure 7.6	:	Variation of <i>EW</i> , disc radii and the <i>V/R</i> ratio of H_{γ} from 2009 to 2010	136
Figure 7.7	:	Variation of EW and disc radii of HeI \lambda6678 from 2009 to 2010	136
Figure 7.8a	:	<i>V/R</i> variation of Ha profile in 2010 varies in accordance with one-armed oscillation disc model	139
Figure 7.8b	:	<i>V/R</i> of Ha in 2011from March to July	140
Figure 7.9	:	Evolution of disc radii with time in different emitting regions during the periaston passage 2011	141
Figures 7.10):	Correlation of EW and FWHM during periastron 2011	142