List of Figures

Figure 1.1: Mean wind speed variation for Calcutta4
Figure 2.1: Comparison of Gamma and Weibull densities16
Figure 2.2: Traces of the extreme value limit distributions in a Gumbel probability
paper [173]
Figure 3.1: Histogram for the years 1969, 1970, 1971 and 1976
Figure 3.2: Determination of optimum value of the class width
Figure 3.3: Histogram for 1977 and 1980 taking 2 <i>km/h</i> class width50
Figure 3.4: Histogram sampled in 0.1 knot
Figure 3.5: Plot of sampling error
Figure 3.6: Contour Plot of Ratio of biased to unbiased Weibull Parameters
Figure 3.7: Comparison of biased and unbiased Weibull pdf and the plot of the ratio
of biased to unbiased Weibull pdf versus wind speed54
Figure 3.8: Inverse contour plot of the ratio of unbiased to biased Weibull parameters.
Figure 3.9: Probability density histogram of observed and simulated pdf at a class
width of 1 <i>km/h</i> and a 2 <i>km/h</i> for Ahmedabad56
Figure 3.10: Probability distribution of wind speed for Ahmedabad
Figure 3.11: Contour plot of wind power density
Figure 4.1: Map of India with the location of the three stations [192]68
Figure 4.2: Variation of k versus E_{pf} and best fitted rational function
Figure 4.3: Comparison of M2 and M3 methods based on the ratio of estimated Shape
parameter to Shape Weibull parameter versus shape parameter for different
sample sizes76
Figure 4.4: Comparison of M2 and M3 methods based on the ratio of estimated Scale
parameter to Scale Weibull parameter versus shape parameter for different
sample sizes77
Figure 4.5: Comparison of seven different methods based on the ratio of estimated
Weibull parameter to true Weibull parameter versus shape parameter for different
sample sizes
Figure 4.6: Comparison of seven different methods based on the absolute error in
mean wind power density versus sample size for different shape parameters83

Figure 4.7: Q-Q plot of wind speed data (a) with and (b) without extreme data for
three stations
Figure 4.8: Histogram of wind speed together with the corresponding Weibull density
and cumulative distribution function. The parameters have been estimated via the
<i>MEPF</i> method at the Ahmedabad station86
Figure 4.9: Histogram of wind speed together with the corresponding Weibull density
and cumulative distribution function. The parameters have been estimated via the
<i>MEPF</i> method at the Trivandrum station87
Figure 4.10: Histogram of wind speed together with the corresponding Weibull
density and cumulative distribution function. The parameters have been estimated
via the MEPF method at the Calcutta station
Figure 4.11: Histogram of (a) wind load and (b) wind power together with the
corresponding Weibull density and cumulative distribution function. The
parameters have been estimated via the MEPF method for all three stations88
Figure 5.1: Capacity Factor and Power Coefficient curves
Figure 5.2: Plot of monthly average wind speed data95
Figure 5.3: Weibull function representing annual wind speed probability density
function, corresponding cumulative distribution function, wind power density,
and corresponding cumulative distribution function for (a) Trivandrum, (b)
Ahmedabad, and (c) Calcutta
Figure 5.4: Weibull function representing monthly wind speed probability density
function, corresponding cumulative distribution function, wind power density,
and corresponding cumulative distribution function for (a) Trivandrum, (b)
Ahmedabad, and (c) Calcutta
Figure 5.5: Month-wise variation of (a) Capacity Factor and (b) Power Coefficient at
different rated wind speeds for Trivandrum, Ahmedabad, and Calcutta at $30 m$
height114
Figure 5.6: Month-wise variation of (a) Capacity Factor and (b) Power Coefficient at
different rated wind speeds for Trivandrum, Ahmedabad, and Calcutta at $60 m$
height115
Figure 6.1: Wind speed distributions and corresponding cumulative distribution
functions for Calcutta
Figure 6.2: Wind speed distributions and corresponding cumulative distribution
functions for Ahmedabad

Figure 6.3: Wind speed distributions and corresponding cumulative distribution
functions for Trivandrum
Figure 6.4: Wind power density distributions and corresponding cumulative
distribution functions for (a) Calcutta (b) Ahmedabad (c) Trivandrum140
Figure 7.1: Deviation of an average number of hours above reference wind speed for
Calcutta on (a) Linear-Linear Scale (b) Log-Log Scale (c) Log-Linear Scale (d)
Linear-Scale
Figure 7.2: Average number of hours above reference wind speed for Trivandrum and
Ahmedabad on (a) Log-Linear Scale (b) Log-Log Scale154
Figure 7.3: Distribution of hourly mean wind speed with some gaps in a year155
Figure 7.4: 3-D plot of month of March with threshold value is represented by pink
colour for Trivandrum station156
Figure 7.5: 3-D plot of September with the threshold value is represented by pink
colour for Ahmedabad station
Figure 7.6: 3-D plot of September with the threshold value is represented by pink
colour for Calcutta station
Figure 7.7: Non-exceedance probability of extremes hourly mean wind speed for
March, sub-annual maxima and annual maxima for Trivandrum161
Figure 7.8: Non-exceedance probability of extremes hourly mean wind speed for
September, sub-annual maxima and annual maxima for Ahmedabad164
Figure 7.9: Non-exceedance probability of extremes hourly mean wind speed for
September, sub-annual maxima and annual maxima for Calcutta
Figure 7.10: Fitting of GPD and Fréchet distribution on extremes hourly mean wind
speed data for March, September for Trivandrum, Ahmedabad, and Calcutta
respectively169
Figure 8.1: Histogram of wind direction together with the corresponding von Mises
and Kato-Jones densities, at the Ahmedabad station
Figure 8.2: Histogram of wind direction together with the corresponding von Mises
and Kato-Jones densities, at the Trivandrum station
Figure 8.3: Histogram of wind direction together with the corresponding von Mises
and Kato-Jones densities, at the Calcutta station
Figure 8.4: Map of India with wind roses at three different stations in (a) Trivandrum,
(b) Ahmedabad, and (c) Calcutta186