List of Figures

1.1 Tuning-fork diagram of the Hubble sequence ........................................ 7
1.2 Attenuation of light from distant astronomical object by foreground dust cloud .......................................................... 9
1.3 The average extinction curve of Galaxy ........................................... 13

2.1 Structure of Biological neuron .......................................................... 23
2.2 McCulloch and Pitts model ................................................................. 24
2.3 Nonlinear model of neuron ................................................................. 25
2.4 Heaviside Function ........................................................................... 26
2.5 Piecewise-linear function ................................................................ 27
2.6 Logistic function ................................................................................ 28
2.7 Single-layer feedforward ANN architecture diagram ...................... 30
2.8 Multilayer-layer feedforward ANN architecture diagram ............... 31
2.9 Recurrent Network ANN architecture diagram .................................. 32
2.10 Block diagram of Supervised learning method ............................... 34
2.11 Mapping the input data space to output data space ....................... 34
2.12 Block diagram of Unsupervised learning method ......................... 35

3.1 Spectral Classification in Optical waveband ................................... 45
3.2 Hertzsprung-Russel diagram .............................................................. 46
CONTENTS

2 1 1 Model of Artificial Neuron .............................. 23
2.1.2 Network Architecture ................................. 29
2.2 Learning and Adaptation ................................ 32
  2.2.1 Supervised learning .................................. 33
  2.2.2 Unsupervised learning ............................... 34
  2.2.3 Neural Network learning rule ....................... 35
2.3 Multilayer Back Propagation Algorithm .................. 38
2.4 Application of ANN in Astronomy ....................... 41

3 Stellar Spectral Classification and Parameterization 43
  3.1 Stellar Spectral Features and Classification ........... 44
    3.1.1 O-type .................................................. 48
    3.1.2 B-type .................................................. 49
    3.1.3 A-type .................................................. 50
    3.1.4 F-type .................................................. 52
    3.1.5 G-type .................................................. 53
    3.1.6 K-type .................................................. 54
  3.2 Automated Stellar Spectral Classification ................. 55
    3.2.1 ANN architecture ..................................... 59
    3.2.2 Simulated data generation for Train set .......... 62
    3.2.3 ANN test sets ........................................ 71
  3.3 ANN performance and Classification Results ............ 75
  3.4 Summary .................................................. 82

4 Segregation of Stars from Galaxies 84
  4.1 Galaxies and their Morphological classification .......... 85
  4.2 Spectral features of galaxy and Star Galaxy Correlation 87
LIST OF FIGURES

3.3 Normalized spectra of O5V star ............................................. 48
3.4 Normalized spectra of B3V star ............................................. 50
3.5 Normalized spectra of A5V star ............................................. 51
3.6 Normalized spectra of F3V star ............................................. 52
3.7 Normalized spectra of G5V star ............................................. 54
3.8 Normalized spectra of K2V star ............................................. 55
3.9 UBV filter system transmission curves .................................... 56
3.10 Flow chart for Handling of Data Base .................................. 58
3.11 Gradient descent rule in error (2+1) curve .......................... 61
3.12 IUE and TAUVEKEX Simulated fluxes comparison plot .......... 64
3.13 Comparison Curve of stellar flux, with and without extinction 66
3.14 Filter response curve of TAUVEKEX satellite ........................ 66
3.15 Integrated IUE/Simulated TAUVEKEX fluxes along with the residues 69
3.16 Flow chart of train set generation for spectral classification 70
3.17 Flow chart of train set generation for extinction classification 71
3.18 Flow chart of test set generation for spectral classification 72
3.19 Flow chart of test set generation for extinction classification 74
3.20 Learning curve of ANN with UVBLUE training set in full spectra mode .......................................................... 75
3.21 Learning curve of ANN with TAUVEKEX training set in full spectra mode .......................................................... 76
3.22 Scatter plots of classification of the IUE stars .................... 77
3.23 Scatter plots of colour excess estimates of the IUE stars with UVBLUE fluxes .................................................... 78
3.24 Scatter plots of colour excess estimates of the IUE stars with UVBLUE bands ....................................................... 79
## CONTENTS

4.3 Automated Star and Galaxy segregation ................................... 92
4.4 Network Architecture ............................................................ 94
4.5 Data Extraction and training-testing set preparation .... 95
   4.5.1 The sources for stellar and galaxy spectra .......... 95
   4.5.2 Generation of the Train and Test sets .......... 97
4.6 Classification Results and Discussion .......... 101
   4.6.1 Band Data ............................................................... 101
   4.6.2 Flux data .............................................................. 102
   4.6.3 Discussion ............................................................ 103
5 Analytical Error calculation .................................................. 105
   5.1 Temporal analysis of light curves and Cross-Correlation .... 106
   5.2 Light curves without measurement errors ........ .... 109
      5.2.1 Analytical estimate of Cross-correlation .... 109
      5.2.2 Comparison with results from simulations .... 113
   5.3 Light curves with measurement errors ........ .... 117
   5.4 Summary .............................................................. 124
6 Conclusion and Future Outlook ............................................. 125
A The average deviation of non normalized Cross-correlation .... 129

References ................................................................. 131
5.4 Same as Figure 5.3, except that $x_2$ and $z_j$ are independent time-series generated from a stochastic $1/f$ noise process (i.e. power spectrum index $\alpha = 1$). 

5.5 Significance and Cross-correlation function for two simulated light-curves with measurement errors.