# CONTENTS

1 Thermal Lens Spectroscopy – An Over View 1

1.1 Introduction 2

1.2 Processes of light-matter interaction 2

1.2.1 Fluorescence 3

1.2.2 Non radiative transition 3

1.2.3 Energy transfer 5

1.3 Photothermal spectroscopy 5

1.3.1 Photoacoustic spectroscopy 6

1.3.2 Photothermal deflection 7

1.3.3 Thermal lens effect 8

1.4 Historical developments of thermal lens studies 9

1.5 Theory of thermal lens effect 12

1.6 Sensitivity of thermal lens technique 17

1.7 Measurement approaches 19

1.7.1 Single beam thermal lens configuration 19

1.7.2 Dual beam thermal lens configuration 20

1.8 Advantages in using photothermal lens spectrometry 21

1.9 Recent applications 22

2 Experimental Details 29

2.1 Introduction 30

2.2 Laser Systems 30

2.2.1 Optical Parametric Oscillator 30

2.2.2 Diode Pumped Solid State laser 32

2.2.3 Argon ion laser 33

2.2.4 Helium-Neon laser 34

2.3 Detectors 34
2.3.1 Digital Storage Oscilloscope 34
2.3.2 Lock-in amplifier 35
2.3.3 Photodetector – Photomultiplier 36
2.3.4 Monochromators 37
2.3.4.1 Spex- 1m Monochromator 38
2.3.4.2 McPherson- 0.2m Monochromator 39
2.3.5 Spectrophotometer 39
2.3.6 Power meters 39
2.4 Other experimental tools 40
2.5 Experimental set up 41
2.5.1 Pulsed laser thermal lens set up 42
2.5.2 Continuous wave thermal lens set up 43
2.5.3 Fluorescence studies 45

3. Study of thermo-optic properties of dye doped polymer 47
3.1 Introduction 48
3.2 Materials 49
3.2.1 Polymer (PMMA) 49
3.2.2 Dyes (Rhodamine 6G) 50
3.3 Method of preparation of dye doped polymer samples 51
3.4 Measurement of fluorescence quantum yield 52
3.4.1 Methods using a standard reference 52
3.4.2 Quantum yield measurements 54
3.4.3 Theory 54
3.4.4 Experimental 57
3.4.5 Results and discussion 58
3.4.6 Conclusion 62
3.5 Thermal diffusivity of Rhodamine 6G doped polymer matrix
3.5.1 Introduction 63
3.5.2 Theory 65
3.5.3 Results and discussion
3.5.4 Conclusion

3.6 Photochemical stability of Rhodamine 6G
Molecules in polymer matrix
3.6.1 Introduction
3.6.2 Results and discussion
3.6.3 Conclusion

4. Energy transfer mechanism in dye mixtures
4.1 Introduction
4.2 Phenomenological descriptions of electron transfer in solutions
  4.2.1 Radiative transfer
  4.2.2 Non radiative transfer
  4.2.3 Excitation migration
4.3 Fluorescein – Rhodamine B system
  4.3.1 Experimental
  4.3.2 Results and discussion
4.4 Rhodamine 6G – Rhodamine B system
  4.4.1 Experimental
  4.4.2 Results and discussion
4.5 Study of fluorescence quantum yield of dyes
  4.5.1 Experimental
  4.5.2 Results and discussion
4.6 Conclusion

5. Thermal lens spectra of aniline and certain organic dyes
5.1 Two photon absorption spectrum of aniline
  5.1.1 Introduction
  5.1.2 Materials