

## TABLE OF CONTENTS

<b>CHAPTER 1: INTRODUCTION</b>	<b>1</b>
1.1 Introduction	1
1.2 Optical Fibre Sensor	2
1.3 Classification of Optical Fibre Sensor	4
1.4 Advantages of Optical Fibre Sensor	8
1.5 Applications of Optical Fibre Sensors	9
1.6 Literature Survey	10
1.7 Problem Statement	14
1.8 Objectives of the Research	15
1.9 Organisation of the Thesis	15
 <b>CHAPTER 2: PROPAGATION OF LIGHT IN A FIBRE WAVEGUIDE</b>	 <b>17</b>
2.1 The Wave Nature of Light	17
2.2 Wave Theory of Optical Waveguide	18
2.3 Attenuation Due to Curvature Loss in a Multimode Optical Fibre	22
2.4 Principle of bare and Tapered Optical Fibre Refractometer	25
 <b>CHAPTER 3: MONITORING OF MOISTURE IN TRANSFORMER OIL USING A BARE AND BENT MULTIMODE OPTICAL FIBRE REFRACTOMETER</b>	 <b>28</b>
3.1 Introduction	28
3.2 Effect of Moisture in Transformer oil	28
3.3 Theory of Macrobending	31
3.4 Artificial Neural Network	34
3.5 Multilayer Feed Forward (MLFF) Network	35

3.6	Description of the Fibre-Optic Refractometer	37
3.7	Experimental Setup for the Instrumentation System	38
3.8	Experimental Procedure	40
3.9	Results and Discussion	41
3.10	Conclusions	46
<b>CHAPTER 4: AN IMPROVED OPTICAL-FIBRE REFRACTOMETER</b>		<b>47</b>
4.1	Introduction	47
4.2	Fundamental Operating Principle of the Refractometer	50
4.3	Description of the Optical-Fibre Sensor Probe	54
4.4	Scheme of the Instrumentation System	55
4.5	Measurement Procedure	61
4.6	Experimental Results and Discussion	62
4.7	Conclusion	66
<b>CHAPTER 5: USE OF IMPROVED OPTICAL-FIBRE REFRACTOMETER FOR THE MONITORING OF DEGRADATION OF LUBRICATING OIL</b>		<b>69</b>
5.1	Introduction	69
5.2	Principle of Bare, Tapered and Bent Multimode Refractometer	76
5.3	Relation between Refractive Index, Viscosity and Temperature	77
5.4	Description of the Optical Fibre Sensor Probe (OFSP)	81
5.5	Scheme of the Instrumentation System for the Optical Fibre Sensor	83
5.6	Experimental Setup for the Instrumentation System	84
5.7	Measurement Procedure for the Optical Sensor	85
5.8	Results and Discussion	87
5.9	Conclusion	91

<b>CHAPTER 6: CONCLUSIONS AND SCOPE FOR FUTURE WORKS</b>	93
6.1 Conclusions	93
6.2 Scope for Future Work	97
<b>Bibliography</b>	98
<b>Appendix 1: Abbreviations Used</b>	107
<b>Appendix 2: List of Publications</b>	109