

CONTENTS

ABSTRACT	i
ABSTRAK	ii
ACKNOWLEDGMENT	iii
CHAPTER 1 INTRODUCTION : FIBER NONLINEARITIES	1
1.1 Non-linear Effects in Optical Fibers	1
1.2 Stimulated Brillouin Scattering (SBS)	3
1.2.1 Brillouin Frequency Shift	5
1.2.2 Brillouin Gain	7
1.2.3 SBS Threshold	10
1.2.4 Reported Experiments on SBS	11
1.2.5 Importance of SBS in Optical Fibers	17
1.3 Four Wave Mixing (FWM)	18
1.4 Stimulated Raman Scattering (SRS)	21
1.5 Self-Phase Modulation (SPM)	22
1.6 Cross-Phase Modulation (XPM)	23
References	24
CHAPTER 2 ERBIUM DOPED RING FIBER LASER	27
2.1 Fiber Based Optical Components	27

2.1.1	Isolator	28
2.1.2	Bi-directional Coupler (Splitters)	28
2.1.3	Wavelength Selective Coupler (WSC)	28
2.1.4	Gain Medium – Rare-earth Doped Fiber (DF)	28
2.1.5	Pump Source - Pigtailed Laser Diode (LD)	30
2.2	General Characteristics of a ring EDFL	31
2.2.1	Slope Efficiency (SE)	32
2.2.2	Laser Threshold and Output Power	32
2.2.3	Free-Spectral Range (FSR) and Linewidth (FWHM)	33
2.2.4	Finesse	35
2.2.5	Side-Mode Suppression Ratio (SMSR)	35
2.3	Cavity Designs	37
2.3.1	Fabry-Perot Cavity	38
2.3.2	Ring Cavity	38
2.4	Characterization of Erbium Doped Ring Fiber Laser	39
2.5	Experiments, Results and Discussion	40
2.5.1	Effects of EDF length	41
2.5.2	Effects of Pump Power (LD Power)	43
2.5.3	Effects of Reflectivity, R	44
2.5.4	Effects of Pump Power and Wavelength Fluctuation	46
2.5.5	Effects of Back Reflection (BR)	48
2.5.6	Tuning Range	49
2.6	Implications to the BEFL System	50

References	51
CHAPTER 3 BRILLOUIN-ERBIUM FIBER LASER (BEFL)	52
3.1 Introduction	52
3.1.1 Experimental Setup	54
3.1.2 Operating Principle	56
3.2 Experiments, Results and Discussion	58
3.2.1 Optimization of EDF length	58
3.2.2 BEFL Threshold	59
3.2.3 Output Power and Slope Efficiency (SE)	62
3.2.4 Tuning Range	69
3.2.5 Effect of Single-Mode Optical Fiber (SMOF) Length	75
3.2.6 Output Signal Power Fluctuation	76
3.2.7 Side-Mode Suppression Ratio (SMSR)	78
References	81
CHAPTER 4 MULTI-WAVELENGTH BEFL (MWBEFL)	82
4.1 Introduction	82
4.1.1 Experimental Setup	83
4.1.2 Operating Principle	85
4.1.3 Multiple Generation Process	87
4.1.4 Lasing Gain and Gain Dynamics	88
4.2 Experiments, Results and Discussion	92

4.2.1	MWBEFL Threshold	92
4.2.2	Output Power	94
4.2.3	Tuning Range	95
4.2.4	Side-Mode Suppression Ratio (SMSR)	97
4.2.5	Maximum Number of Stokes Signal	98
4.3	Implications Towards Optical Communications	102
	References	104
	CHAPTER 5 CONCLUSION	105
	APPENDICES : OUTPUT OF THIS DISSERTATION	108
	Appendix A Papers Published	109
	Appendix B Exhibited Prototype Model	112