CONTENTS

LIST OF NOTATIONS 4

INTRODUCTION 5

CHAPTER 1. LITERATURE REVI EW 13

1.1. General properties of dielectric resonators 13
1.2. Microlasers as dielectric resonators with active regions 17
1.3. Methods of analysis of passive dielectric resonators 24
1.4. Modeling of open resonators with active regions 28

CHAPTER 2. SPECTRA AND THRESHOLDS OF LASING OF THE MODES OF CIRCULAR RESONATORS 35

2.1. Reduction of dimensionality of boundary-value problem 35
2.2. Formulation of the lasing eigenvalue problem 42
2.3. Modes of a uniformly active circular resonator 46
2.4. Modes of a resonator with the radially inhomogeneous active region 58
2.5. Conclusions for Chapter 2 64

CHAPTER 3. MODES OR MULTI-LAYERED CIRCULAR RESONATORS 66

3.1. Dipole-type supermodes of an active disk in a passive ring 67
3.2. Whispering-gallery supermodes of a resonator in an annular Bragg reflector 77
3.3. Optical Theorem for the modes of open resonators 82
3.4. Overlap coefficients between the active region and the mode field 88
3.5. Conclusions for Chapter 3 102

CHAPTER 4. MODES OF PHOTONIC MOLECULES AS OPTICALLY COUPLED CIRCULAR RESONATORS 104

4.1. Supermodes of two identical active resonators 105
4.2. Whispering-gallery supermodes in cyclic photonic molecules 118
4.3. Supermodes built on the monopole and dipole modes 127
4.4. Conclusions for Chapter 4 135

CHAPTER 5. MODES OF RESONATORS WITH ARBITRARY SMOOTH CONTOURS 137

5.1. Muller boundary integral equations 138
5.2. Integral equations discretization using the quadratures 144
5.3. Modes of an active resonator with a spiral contour 149
5.4. Conclusions for Chapter 5 159

GCONCLUSION 161

LIST OF REFERENCES 164

LIST OF NOTATIONS

GO – Geometrical Optics

RP – radiation pattern

DR – dielectric resonator

IE – integral equation

ABR – annular Bragg reflector

FDTD – Finite Difference Time-Domain

DE – directivity of emission

WG – whispering gallery

ERI – effective refractive index