1. INTRODUCTION

In the last decade the fields of fiber and integrated optics have seen vigorous research and developmental efforts throughout the world. The basic of this emerging discipline of science and technology is an optical waveguide. Several books /1-16/ and reviews /17-20/ are available now on these topics. However, to our opinion it is difficult to use any of these straightaway to develop an unified syllabus for class room teaching of optical waveguides. In the following we have tried to outline a course structure on optical waveguides with the aim of making it a basic course on the subject so that the students are well prepared to undertake detailed R&D work on one or more areas of its special applications. In part I, after a discussion of the course approach, we outline theory course topics while in part II we attempt to provide guidelines for some experiments which should supplement the theoretical knowledge.

2. PART I: THEORY

2.1. Course approach:

In introducing a new course it is instructive to devote some time on the motivation behind its introduction. Introductory lectures should therefore discuss topics like: potentiality of optical waveguides to yield optical devices in microstructures owing to their dimensions being comparable to optical wavelengths /20/, large information carrying capacity at optical frequencies /21/, advantages of optical fibers and integrated optics /20, 21/, development of high purity materials and composites for realizing low loss waveguides, semiconductor lasers, and photodetectors /8/.

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Descriptions of propagation effects in multimode waveguides are documented in several books. However, the following discussions are often missing in these books: utility of the knowledge of modal fields in power coupling estimations, physical interpretation of integers identifying a mode, cladding modes and the necessity of stripping these modes in fiber characterization experiments, the consequence of the existence of a narrow boron-doped inner cladding and axial index dip in real CVD-fibers, utility of differential mode delay characterization of a multimode fiber for correcting preform fabrication process, multiple α-profiled fibers, and so on.

In view of the recent emergence of monomode fibers as i) most suitable media for longhaul high capacity optical transmission systems and ii) being most suited for a majority of fiber sensors, it is necessary to include a detailed description of waveguidance in monomode fibers. For example, the rigorous calculation of the $\frac{d^2 B}{d \omega^2}$ term for predicting the minimum dispersion wavelength /22/, which is an important monomode fiber design parameter. Due to the deviation of practical monomode fibers from an ideal step index profile, the concept of equivalent step index profile (ESI) /23, 24/ and the variational method /25, 26/ for the fundamental mode field have assumed great importance in the prediction of monomode fiber performance. In the same context the two-mode fibers also have assumed some importance because of the possibility of achieving zero dispersion even in these fibers /27/ in addition to the benefit of greater splicing tolerances /28/.

Another topic which has attracted attention is the technology of fiber optic sensors. A number of fiber optic sensors /29/ have already been demonstrated e.g. hydrophones, magnetometers, gyroscopes, liquid level, bubble and pressure sensors. Broadly all these sensors are based on phase or intensity modulation of light propagating through a fiber by the external stimulus to be sensed. Polarization properties of monomode fibers, e.g. birefringence, beat length, polarization maintenance etc. require tutorial level discussions to form the foundations for undertaking R&D studies on fiber sensors relying on phase measurements.

2.2. Course topics:

2.2.1. Introduction: definition of optical waveguides, advantages of optical waveguide devices, and large information carrying capacity at optical frequencies.

2.2.2. Pre-requisite optics and electromagnetic wave theory: Maxwell's