



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER
1

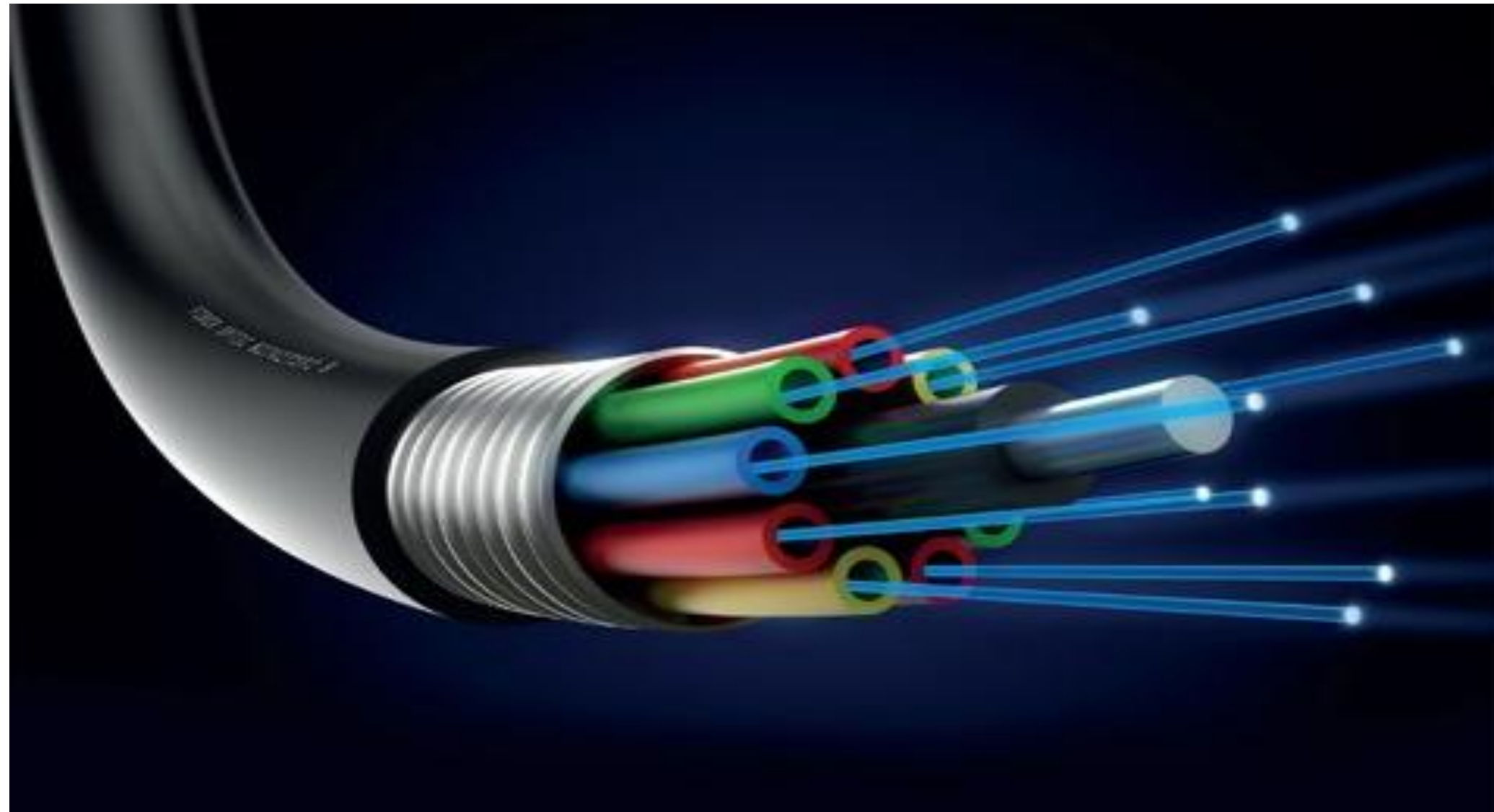
UNIT 4 – OPTICAL COMMUNICATION

TOPIC – OPTICAL FIBERS AND DEVICES-PROPAGATION OF LIGHT,

OPTICAL FIBER STRUCTURES



OPTICAL COMMUNICATION





CONTENTS



- Introduction
- General communication system
- Optical fiber link
- Fiber structure
- Fiber types
- Optic fiber configuration
- Ray theory transmission



INTRODUCTION

- Communication – transfer of information from one point to another.
- Communication system- transfer of information is achieved by modulating the information onto an electromagnetic wave which acts as a carrier for the information signal.
- Electromagnetic wave carrier is selected from
 - »Radio frequencies
 - »Microwave & millimeter wave frequencies
 - »Optical range of frequencies
- Limitation- information carrying capability.
- Information carrying capability is proportional to the bandwidth of the channel.



- **Radio Communication System**

- Information modulates a high frequency carrier.
- Information carrying capability – increased.

Bandwidth of the channel – increased.

Available spectrum space – decreased.

- **Microwave signal**

- » Used as high frequency carriers (1-300GHz).
- » Cost of equipment – high.

- **Communication by light**

- ✓ Light act as transmission medium.
- ✓ Electromagnetic wave carrier- optical range of frequencies (1.76 pHz to 3.75 pHz).
- ✓ Communication at optical wavelength (800nm to 1700nm) offer a increase in bandwidth by factor of 10^4 .



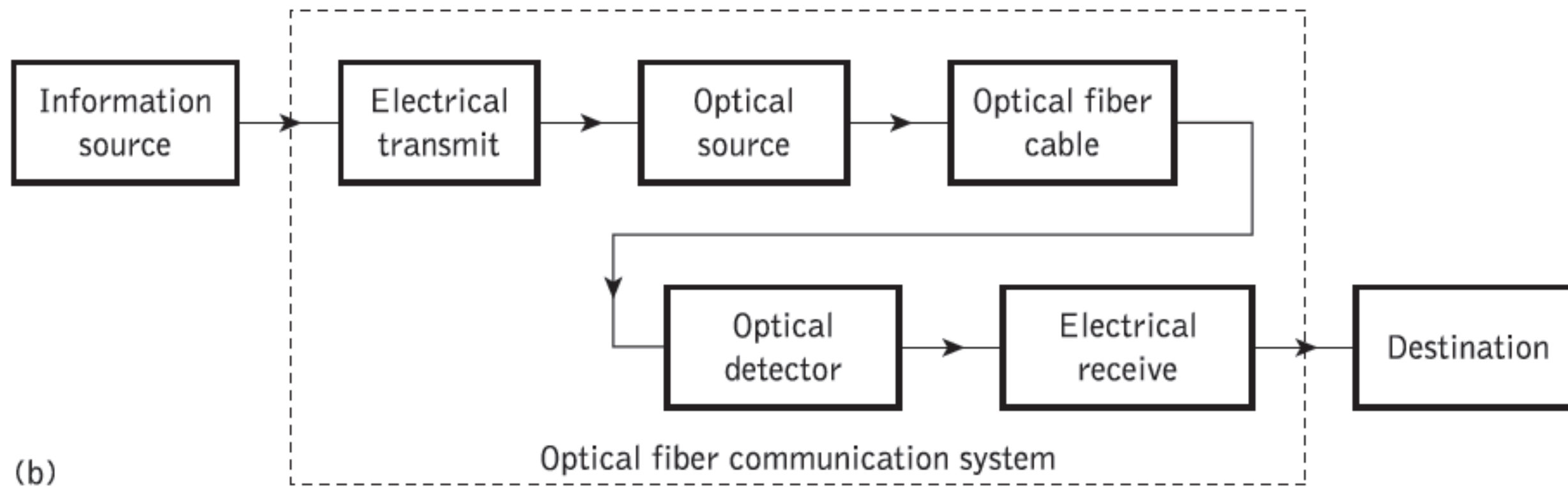
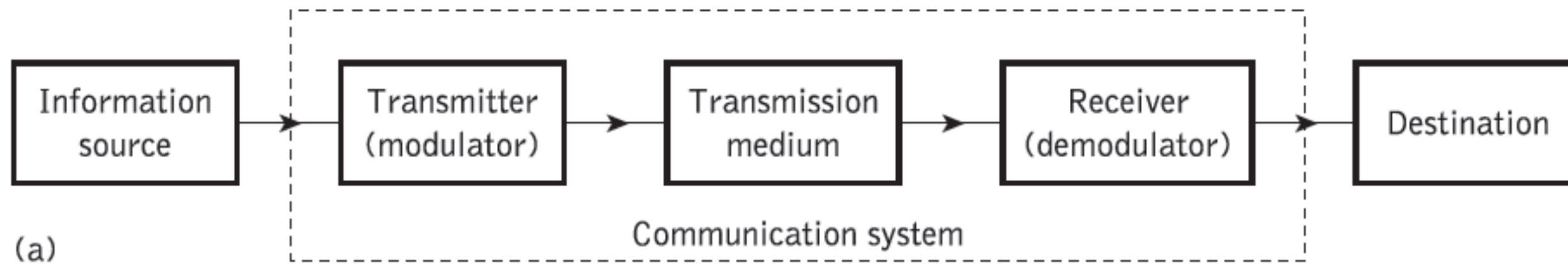
- **Information put on a light beam** and transmitted through Free space
 - Impractical over long distance. Because, attenuation occurs due to atmospheric effects like rain, snow, fog etc.

Special cable- light carrying cable

- Optical fiber is a glass or plastic fiber that carries light along its length.

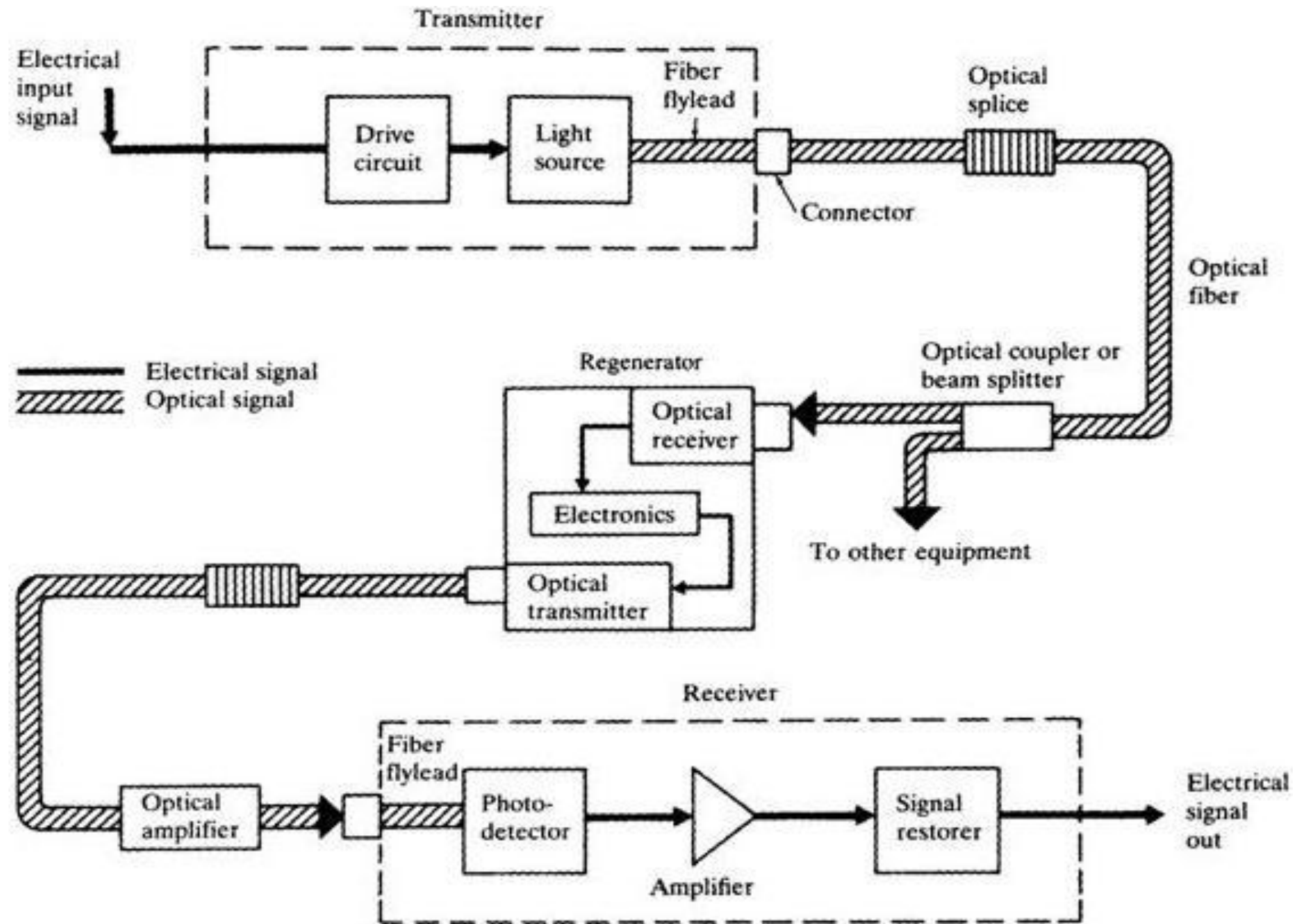


General Communication System



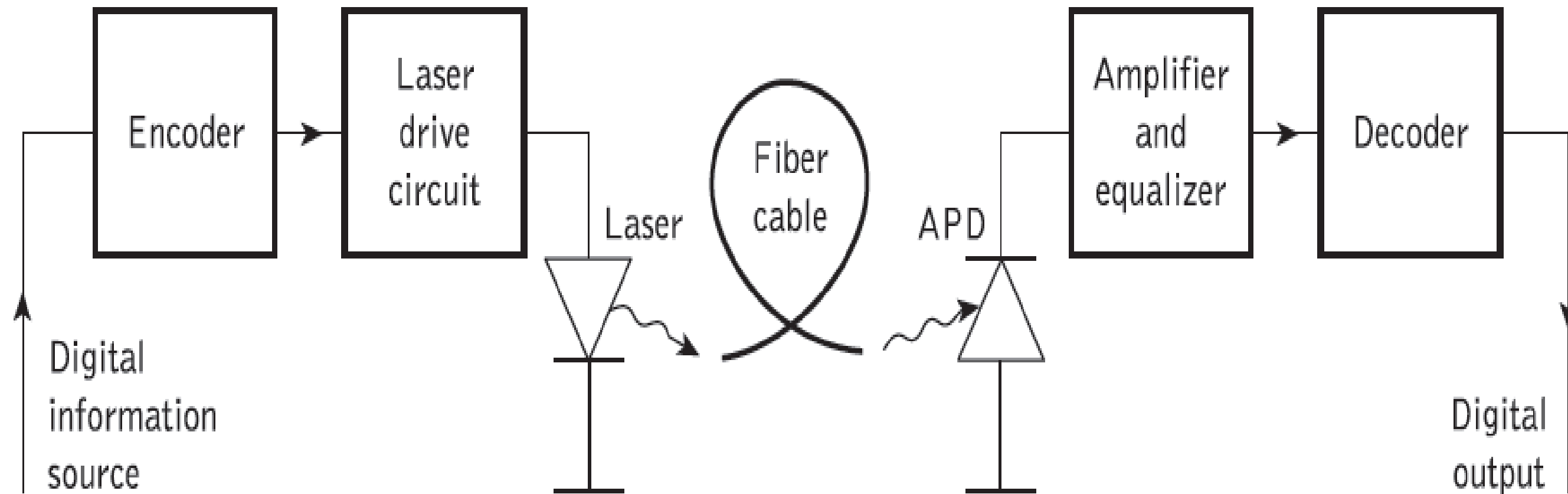


Optical Fiber Comm. Link





Digital Optical Fiber link





Optical Fiber Modes



- Optical fiber
 - Dielectric waveguide
 - Operates at optical frequency
 - Cylindrical in form
- Modes of the waveguide – the propagation of light along a waveguide can be described in terms of set of electromagnetic waves.
- These guided modes are referred to as bound or trapped modes of the waveguide.



Fiber Structure



■ It has

- ◆ Core
- ◆ Cladding.

■ Core

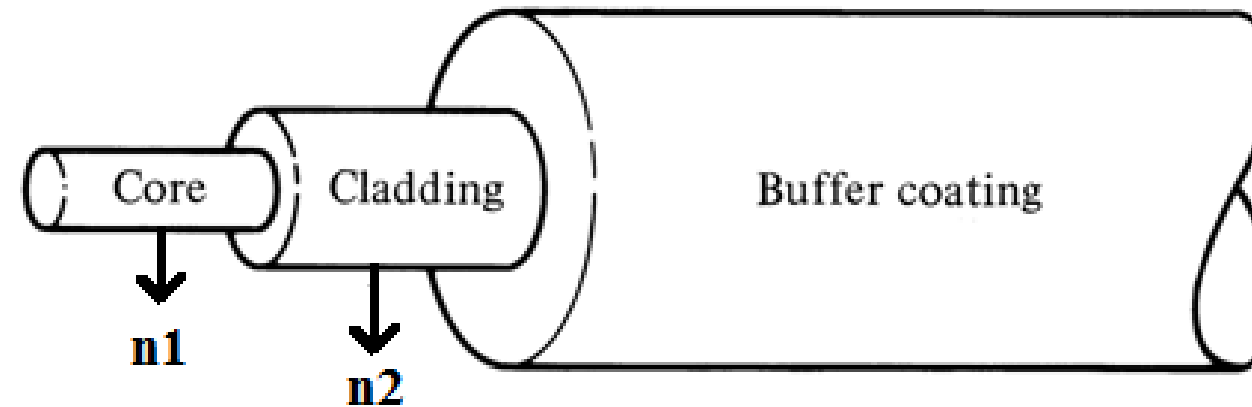
- ◆ Single solid dielectric cylinder
- ◆ Refractive index – n_1

■ Cladding

- ◆ Core is surrounded by cladding.
- ◆ Refractive index – n_2 & $n_2 < n_1$.

■ Need for cladding

- ◆ Reduces scattering loss
- ◆ Provides mechanical strength
- ◆ Protects core from absorbing surface contaminants.



■ Buffer coating

- ◆ Elastic, absorption resistant material
- ◆ Use- add further strength to the fiber



FEATURES



- » Ultra high bandwidth
- » Small size and weight
- » Electrical isolation
- » Immunity to interference and crosstalk
- » Signal security
- » Low transmission loss
- » Ruggedness and flexibility
- » System reliability and ease of maintenance
- » Potential low cost
- » Point to point communication



APPLICATIONS



- Long distance communication backbones
- Inter-exchange junctions
- Video transmission
- Broadband services
- Computer data communication (lan, wan etc..)
- Military application
- Non-communication applications (sensors etc...)

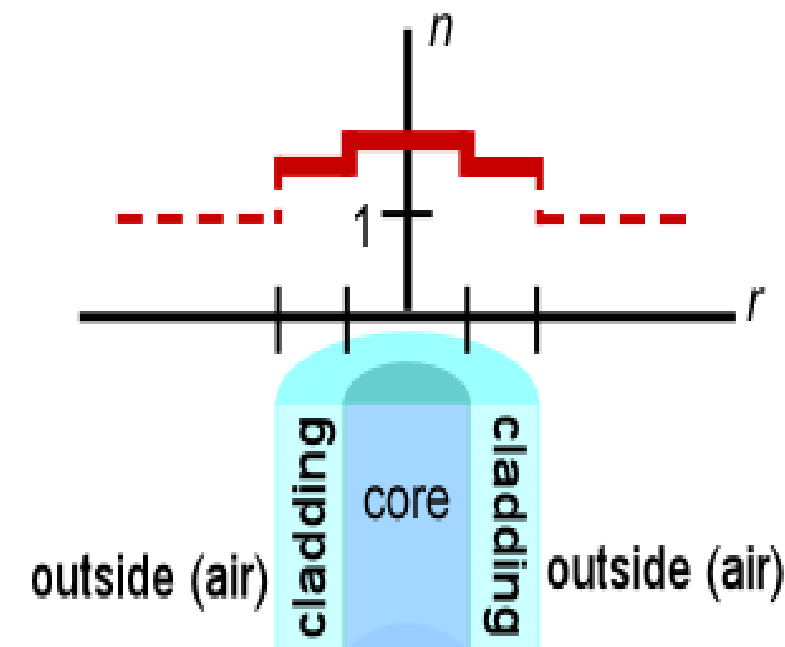


FIBER TYPES

✓ Variation in material composition of the core gives 2 types of fiber.

- **Step index fiber**

- » Refractive index of core is uniform throughout and undergoes an abrupt change at the core cladding boundary.



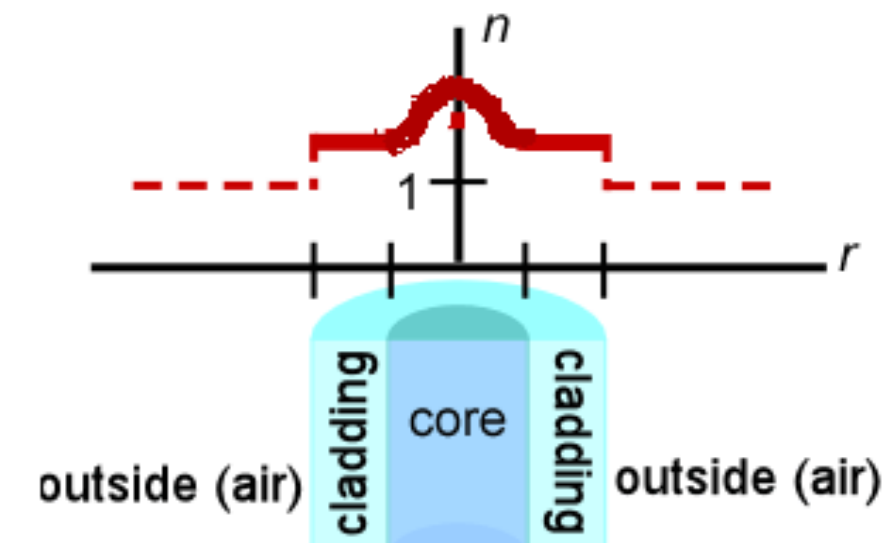


FIBER TYPES



- **Graded index fiber**

- » Refractive index of core is made to vary as a function of radial distance from the centre of the fiber.



- ✓ Based on modes 2 types of fibers are available.

- ✓ Single Mode Fiber.

- ✓ Multi Mode Fiber.



Comparison



Single mode fiber

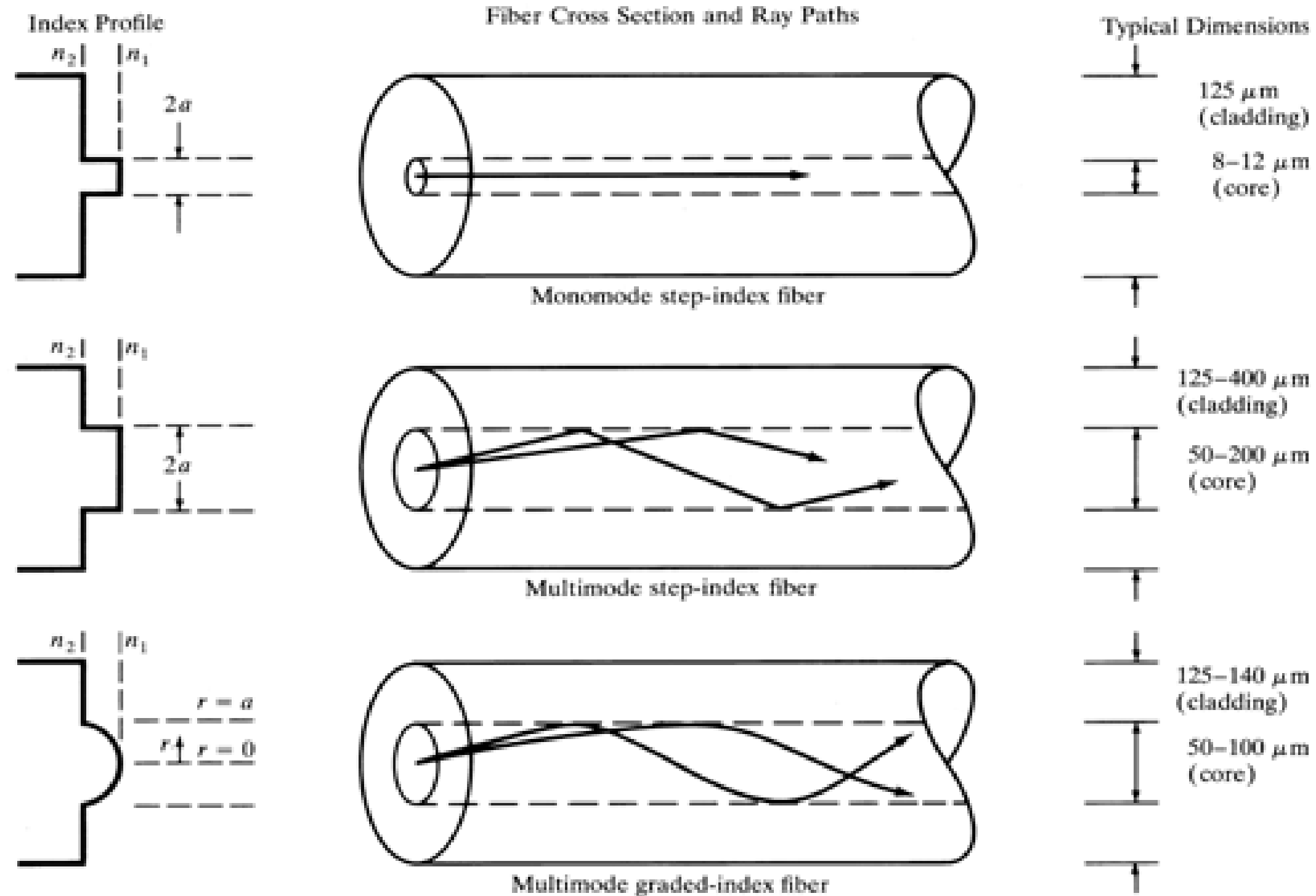
- ▶ Core radius is small.
- ▶ Supports one mode of propagation.
- ▶ Optical source- LASER.
- ▶ The launching of optical power into fiber is difficult as the core radius is small.
- ▶ Supports larger bandwidth.
- ▶ Intermodal dispersion is absent.
- ▶ Used for long distance communication.

Multi mode fiber

- ▶ Core radius is large.
- ▶ Supports hundreds of modes.
- ▶ Optical source- LED.
- ▶ The launching of optical power into fiber is easier as the core radius is large.
- ▶ Supports lesser bandwidth.
- ▶ These fiber suffer from Intermodal dispersion.
- ▶ Used for short distance communication.



Optic-fiber Configuration





THANK YOU