Abbes Laghrour university

L3 Télécommunication

Optoélectronique

Final exam and key answer

1- Describe the structure of an optical fiber and explain the different existing types of fibers.

2- What is the role of a photodiode in a communication system? Explain the difference between a PIN photodiode and an APD (Avalanche Photodiode)

3- Recall the concept of dispersion and explain its effect on transmission.

4- What are the connection techniques between fibers?

5- What are the connectivity defects that can occur?

Answer key

1- Structure and Types of Optical Fiber

- Structure: An optical fiber consists mainly of three layers: the Core (carries the light), the Cladding (reflects light back into the core), and the Coating/Buffer (protective plastic layer).
- Types:
    - Single-mode (SMF): Very thin core, carries only one light path, used for long distances.
    - Multi-mode (MMF): Larger core, carries multiple light paths, used for short distances (LANs). According to refractive index profile, there are two subcategories ; step-index multimode optical fiber and graded-index multimode optical fiber

2- Role and Types of Photodiodes

- Role: It acts as a receiver that converts light signals (photons) into electrical signals (electrons).
- PIN vs. APD:
    - PIN: Simple, reliable, and inexpensive, but lacks internal gain.
    - APD (Avalanche Photodiode): Provides internal gain (amplification), making it much more sensitive and suitable for long-distance transmission, though it is more complex and expensive.

3- Dispersion and its Effect

- Dispersion is the spreading out of light pulses as they travel along the fiber.
- Effect: It causes Inter-Symbol Interference (ISI), where pulses overlap, limiting the maximum data rate (bandwidth) and the transmission distance.

4- Connection Techniques

- Fusion Splicing: Melting two fibers together with an electric arc (permanent, very low loss).

- Mechanical Splicing: Aligning fibers in a sleeve with index-matching gel (quick/emergency).
- Connectors: Plug-and-play devices (SC, LC, ST) for easy connecting/disconnecting to equipment.

5- Connectivity Defects

- Contamination: Dust on the fiber end-face (most common).
- Misalignment: Lateral, angular, or longitudinal gap between cores.
- Reflectance: Back-reflections caused by air gaps between connectors.
- End-face damage: Scratches or cracks on the glass surface.