



OPTIC FIBRES - SCI & TECH GS III MAINS

Q. The evolution of fiber optics has revolutionized communication and connectivity, offering high-speed, reliable data transmission. Elucidate (10 marks, 150 words)

News: *What is fibre optic cables and how do they work? | Explained*

What's in the news?

- COVID-19 pandemic highlighted the crucial role of the internet in maintaining global connectivity, facilitated largely by high-speed internet connections.
- These connections, enabling video chats, online payments, and virtual meetings, largely depend on the technology of optical fibers.

Optical Fibers:

1. Composition and Size:

- Optical fibers are thin strands of glass, almost as thin as a human hair, used for transmitting information.

2. Information Transmission:

- They carry various forms of data, including text, images, and videos, at speeds close to that of light.

3. Everyday Relevance:

- Optical fibers play a vital role in everyday communications like text messaging and phone calls.

4. Fragility vs. Strength:

- Despite their thinness, these fibers are strong and durable when encased in protective materials.

5. Versatility:

- They are flexible enough to be laid underground, underwater, or wound around spools.

Working of Optical Fibers:

1. Light as an Electromagnetic Wave:

- Light, part of the electromagnetic spectrum, can be controlled and guided through optical fibers.

2. Total Internal Reflection:

- This phenomenon allows light to travel long distances within the fiber with minimal loss of power.

3. Fiber Optic Communication System:

- This system includes a transmitter, the optical fiber, and a receiver to encode, carry, and reproduce information.

4. Data Transmission and Resistance:

High Data-Transmission Rate:



- Optical fibers can transmit data at rates of several terabits per second.

Insensitivity to External Disturbances:

- Unlike copper cables, they are not affected by external factors like lightning or bad weather.

Development of Fiber Optic Cables:

1. Early Experiments:

- The concept of guiding light in transparent media dates back to the 19th century, with demonstrations by Jean-Daniel Colladon and others.

2. Medical and Defence Applications:

- Early glass objects were used in medicine and defence before their adaptation for data transmission.

3. Advancements in the 20th Century:

- Significant progress occurred in the 1950s and 1960s, including the development of glass-clad fibers and the invention of lasers.

Modern Manufacturing:

1. Fiber-Optic Cable Production:

- Today, glass fibers are produced using the fiber-drawing technique, ensuring high purity and engineered refractive index profiles.

2. Loss Reduction:

- Modern optical fibers have significantly reduced signal loss, less than 0.2 dB/km.

Future of Fiber Optics:

1. Expanding Applications:

- Fiber optics technology is now integral to various fields, including telecommunication, medical science, and laser technology.

2. India's National Mission:

- The Indian government's 2020 Union Budget announced a significant investment in quantum technologies and applications, highlighting the future potential of fiber optics.

3. Quantum Optics and Communication:

- The technology stands at the forefront of a new era, with expanding possibilities in quantum optics and home connectivity.

The evolution of fiber optics has revolutionized communication and connectivity, offering high-speed, reliable data transmission. As the technology continues to advance, its applications are likely to expand further, driving innovations in various sectors and enhancing global connectivity.