Overview - Fiber Optics

1. What is optical Fiber
2. How optical fiber is better than coaxial copper cable (i.e. advantages of using optical fibers) - more data carrying capacity (band width, band width is proportional to frequency of carrier wave), more security, least electromagnetic interference (EMI).
3. Principle of working - Total Internal Reflection
4. Explain Total Internal Reflection
5. Composition/structure of optical fiber (discuss three layers core, clad and protective sheath along with materials i.e. glass or plastic)
6. How light propagates through fiber - Explain qualitatively and show with the help of diagram.
7. Define acceptance angle, acceptance cone and numerical aperture. Find their mathematical expression/relation. Give physical significance of each.
8. What is Δ - fractional change in refractive index and express numerical aperture in terms of Δ.
9. What is mode?
10. Classification of optical fibers :

    (i) Based on Index Profile of core -Step Index (SI) and Graded Index (GRIN). Plot the respective index profiles.

    (ii) Based on number of modes - Single Mode Fiber (SMF) and Multimode Fiber (MMF)

11. What is V-no of fiber - $V = \frac{2\pi a \, N.A.}{\lambda}$, where **a** is core radius, **λ** is wavelength of carrier wave; N.A. is numerical aperture of fiber. Cut off value of V is 2.405, if V<2.405, fiber is SMF and if V>2.405, fiber is MME. Note that V-no of fiber is also known as Normalized frequency.
12. Various losses through fiber - absorption, scattering, material, bending, coupling loss etc.
13. Attenuation coefficient $\alpha = \frac{10}{L}\log_{10}\frac{P_{in}}{P_{out}}$, where L is length of fiber in km, P_{in} is input power launched into fiber and P_{out} is output power from the fiber. Units of α are dB/km.
14. Joints in optical fibers - (i) Splice - permanent joint to increase the length of fiber - two types: mechanical splice n fusion splice (ii) Connector - semi-permanent/temporary joint to connect fiber with transmitter and/or receiver - can be of two types - mechanical (ferrule type) and extended beam connectors (iii) Coupler: device to split and/or combine optical signal from one port to many ports or many to one.
15. Applications of optical fibers - communication system, sensors.
16. Disadvantages of using optical fibers