

FIBRE OPTIC INSTRUMENTATION

1. Answer the following questions. 2x10

- (a). Define "Integral Power Efficiency" and "External Power Efficiency" of LED.
- (b). Distinguish between "Spontaneous Emission" and "Stimulated Emission".
- (c). Write the expression of the "Normalised Frequency". What is the importance of this parameter ?
- (d). Why the photo multiplier and pyro electric detectors are not suitable for optical fiber systems ? Mention a suitable photo detector for optical fiber system, with reasons.
- (e). Using Snell's law derive the expression of the "Angle of Acceptance" and "Numerical Aperture" of an optical fiber having refractive index of the core and cladding n_1 and n_2 respectively.
- (f). Define "Reflectivity" and "reflection coefficient" at the fiber core end-face.
- (g). Write the expression of the maximum theoretical Optical Power coupling efficiency for a fiber of radius "a", source radius "rs" and refractive index of the core and cladding n_1 and n_2 respectively.
- (h). What is the "Sagnac Effect" used in fiber Optic sensors ?
- (i). Draw the schematic diagrams showing the measurement of longitudinal displacement, lateral displacement and angular displacement using intensity modulated optical sensor.
- (j). What do you mean by "Two Wavelength System" in fiber-optic measurement systems ? What is the importance of this ?

2. (a). Explain the basic principle of operation of LASER sources. 5
(b). describe the construction of Fabry Perot Resonator. What is the purpose of using this resonator in LASER sources ? 5
3. (a). Describe the construction and operation of PIN photo diode. 4
(b). Describe mathematically the characteristics of photo current resulting from power Absorption by a photo detector. 2
(c). Define "quantum efficiency" in photo diode. 2
(d). How the "responsivity" is related to "Quantum efficiency" ? 2
4. Describe in brief, how the "quantum noise" and "Dark current noise" are generated in photo detector current. Also derive the expression of "Total Noise Current" and "single-to-Noise ratio". 10
5. (a). Explain the phenomenon of "multi path Time Dispersion". 2
(b). Derive the expression of Pulse Broadening per unit length of traversal of optical signals due to multi path Time-Dispersion in a step index fiber. 5

- (c). explain how the Multi-Path time Description is reduced using graded-index fiber. 3
6. (a). describe several possible lensing schemes for coupling improvement between an optical source and an optical fiber. 5
(b). Why "Non-Imaging Micro sphere" is used in optical power launching and coupling ? Show that the focal point of micro sphere can be located on its surface with certain assumptions. 5
7. (a). Show mathematically the occurrence of constructive and destructive interface in an interferometer. 3
(b). Describe the construction, operation and application of Michelson Interferometer. 3
(c). describe how the modulation of wavelength by Transmission medium is achieved using 4
(i). Littrow Diffraction grating
(ii). Fresnel Zone Plate.
8. Write short notes on any two: 5x2
(a). reasons of optical attenuation due to Absorption, scattering and Fiber bending.
(b). Semiconductor optical amplifier.
(c). "Fiber Optic Bragg grating sensor" and also "Fiber-Optic Gyroscope".