

Total number of printed pages – 7

B. Tech
CPEN 5304

Sixth Semester Examination – 2008

FIBRE OPTIC INSTRUMENTATION

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.

1. Answer the following questions : 2×10
 - (a) Define “Internal Power Efficiency” and “External Power Efficiency” of LED.
 - (b) Distinguish between “Spontaneous Emission” and “Stimulated Emission”.

P.T.O.

- (c) Write the expression of the "Normalised Frequency". What is the importance of this parameter?
- (d) Why the photo multiplier and pyroelectric detectors are not suitable for optical fibre systems? Mention a suitable photo-detector for optical fibre system, with reasons.
- (e) Using Snell's law derive the expression of the "Angle of Acceptance" and "Numerical Aperature" of an optical fibre having refractive index of the core and cladding n_1 and n_2 respectively.
- (f) Define "Reflectivity" and "Reflection Coefficient" at the fibre-core end-face.

- (g) Write the expression of the maximum Theoretical Optical Power coupling efficiency for a fibre of radius "a", source radius " r_s " and refractive index of core and cladding are n_1 and n_2 respectively.
- (h) What is "Sagnac Effect" used in fibre 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 fibre-optic measurement systems? What is the importance of this?

2. (a) Explain 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 a 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 the photo detector current. Also derive the expression of "Total Noise Current" and "Signal-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 fibre. 5
- (c) Explain how the multi-path Time Dispersion is reduced using Graded-index fibre. 3
6. (a) Describe several possible lensing schemes for coupling improvement between an optical source and an optical fibre. 5

(b) Why "Non-Imaging Microsphere" is used in optical power launching and coupling ? Show that the focal point of the microsphere can be located on its surface with certain assumptions. 5

7. (a) Show mathematically the occurrence of constructive and destructive interference 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

(i) Littrow Diffraction Grating

(ii) Fresnel Zone Plate. 4

8. Write short notes on any two: 5×2

(a) Reasons of optical power attenuation due to Absorption, Scattering and Fibre bending

(b) Semiconductor optical amplifier

(c) "Fibre Optic Bragg Grating Sensor" and also "Fibre-Optic Gyroscope".