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".

(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 Theoritical Optical Power coupling effi-ciency 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 displace-ment 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 "Singal-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 occurance 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".

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