GUJARAT TECHNOLOGICAL UNIVERSITY PDDC - SEMESTER-V. EXAMINATION - SUMMER 2016

Subject Code:X51102

Subject Name:Optical Communication

Time:02:30 PM to 05:00 PM

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- **Q.1** Answer the following questions: $(7 \times 2 \text{ Marks})$
 - What do you mean by the transmission windows of optical fiber 1 communication?
 - 2 What is equilibrium numerical aperture?
 - 3 A graded-index fiber has a core with a parabolic refractive index profile which has a diameter of 50 µm. The fiber has a numerical aperture of 0.2. Calculate the total number of guided modes propagating in the fiber at a wavelength of 1 μ m.
 - Explain dispersion-shifted fibers. 4
 - Define the terms: (i) Optical confinement (ii) Carrier confinement related to the 5 optical source.
 - 6 Define the terms: (i) Quantum efficiency (ii) Responsivity related to photo detector.
 - Explain concept of WDM. 7
- **O.2 (a)** Answer the following questions: (4+3 Marks)
 - Draw optical fiber transmission link showing all major elements. Write 1 applications of optical fiber communication system.
 - 2 Explain how fibers are made from the perform using fiber-drawing apparatus.
 - (b) Explain Snell's law and obtain the conditions for total internal reflection of ray. 07 Also explain the acceptance angle when launching light into an optical fiber.

OR

- (b) What are fiber modes? Explain mode-field diameter (MFD) and discuss the 07 propagation modes in single-mode fibers.
- Write a brief note on basic attenuation mechanisms in fiber optics. After 07 Q.3 **(a)** travelling a certain distance, the power of a signal is reduced to half. What is the attenuation in dB? If the attenuation is 6 dB, What is the signal power at that point relative to input signal power?
 - Answer the following questions: (4+3 Marks) **(b)**
 - Describe classification of fiber based on modes of propagation & index 1 profile, with diagram.
 - Show that the delay difference δTs between extreme meridional ray and 2 axial ray in multimode step index fiber is $(Ln_1\Delta)/c$.

OR

- Compare edge emitters and surface emitters. Find the expression of internal 0.3 07 (a) quantum efficiency and optical power generated by LED. 07
 - Answer the following questions: (4+3 Marks) **(b)**
 - Explain typical Raman amplification system. 1
 - What is fiber splicing? Explain any one fiber splicing technique in detail. 2

Date:13/05/2016

Enrolment No.

Total Marks: 70

07

14

07

- Q.4 (a) Discuss Fabry-Perot resonator cavity for a laser diode. A GaAs laser diode has a 500-μm cavity length which has an effective absorption coefficient of 10 cm⁻¹. For uncoated facets the reflectivities are 0.32 at each end. What is the optical gain at the lasing threshold?
 - (b) An InGaAs pin photodiode has the following parameters at a wavelength of 1300 nm: $I_D = 4 \text{ nA}$, $\eta = 0.90$, $R_L = 1000 \Omega$, and the surface leakage current is negligible. The incident optical power is 300 nW (-35dBm), and the receiver bandwidth is 20 MHz. Find the various noise terms of the direct detection type optical receiver and hence SNR.

OR

- Q.4 (a) Derive the equation for the power launched from LED source into a graded-index fiber. A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index of 1.48. If the fiber end and the source are in close physical contact, what is the power loss in decibels from the source into the fiber?
 - (b) Solve the following examples:
 - 1

(b)

07

07

07

A glass fiber exhibits material dispersion given by $\left|\lambda^2\left(\frac{d^2n}{d\lambda^2}\right)\right|$ of

0.025.Estimate the rms pulse broadening per kilometer at a wavelength of 0.85 μ m for LED with an rms spectral width of 20 nm.

- 2 Consider an EDFA being pumped at 980 nm with a 30-mW pump power. If the gain at 1550 nm is 20 dB, then find the maximum input power.
- **Q.5** (a) Answer the following questions: (4+3 Marks)
 - 1 Explain rise time budgeting in digital fiber optic system
 - 2 Explain operational concept of a three-port optical circulator.
 - (b) Answer the following questions: (4+3 Marks)
 - 1 Explain the eye diagram showing the key performance parameters.
 - 2 Describe the basic sections of an optical receiver.

OR

- Q.5 (a) Describe SONET/SDH rings in detail and show the configurations of it. 07
 - Answer the following questions: (4+3 Marks) 07
 - 1 Explain typical WDM link containing various components.
 - 2 Explain test set-up for using the insertion-loss technique for attenuation measurement of cables that have attached to connectors.
