Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: X 51102 Date: 29-05-2014

Subject Name: Optical Communication

Time: 02:30 pm - 05:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Mention the advantages of optical fiber as waveguide over conventional metallic waveguide. Plot the three transmission windows of optical fiber communication and explain in brief. **07**

(b) Explain the principle used in the working of fibers as light guides. Light travelling in air strikes a glass plate at an angle $\theta_1=33^o$, where θ_1 is measured between the incoming ray and the glass surface. Upon striking the glass, part of the beam is reflected, and part is refracted. If the refracted and reflected beams make an angle of 90^o with each other, what is the refractive index of the glass? What is the critical angle for this glass? **07**

Q.2 **(a)** Answer the following questions: **07**

1 Explain Outside vapor-phase oxidation technique for the fabrication of optical fiber.

2 Calculate the number of modes at 820 nm in a graded-index fiber having a parabolic-index profile ($\alpha=2$), a 25-μm core radius, $n_1=1.48$, and $n_2=1.46$.

(b) What do you mean by normalized frequency V of the fiber? On the basis of normalized frequency and propagation mode, differentiate between single mode and multimode fibers. **07**

OR

(b) Derive the expression for the numerical aperture of graded index fiber. Compare step index and graded index fibers with respect to numerical aperture and ray transmission in fiber. **07**

Q.3 **(a)** Obtain the expression for group delay τ_{mat} resulting from the material dispersion. From this also deduce the relation for the pulse spread σ_{mat} in terms of material dispersion $D_{mat}(\lambda)$, spectral width of source σ_λ, and length L, the distance traveled in the optical waveguide. **07**

(b) Solve the following example: **07**

1 A certain optical fiber has an attenuation of 0.6 dB/km at 1300 nm. If an optical power of 150 μW is initially launched into the fiber what is the power level in μW at 20 km?

2 Find the rms pulse broadening per kilometer for a graded-index fiber having an optimum parabolic index profile, the core index $n_1=1.49$ and relative index difference $\Delta=1.0\%$.

OR

Q.3 **(a)** Explain major requirements for optical fiber sources. List different LED structures. Describe any one in detail. **07**

(b) Solve the following example: **07**

1 A double-heterojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and nonradiative recombination times of 25 ns and 90 ns, respectively. The drive current is 35 mA. Find the internal quantum efficiency and the internal power level.

2 Consider an LED that has a circular emitting area of radius 35 μm and a lambertian emission pattern with 150 W/(cm^2.sr) axial radiance at a given drive current. Calculate the optical power coupled into step-index fiber which has a core radius of 50 μm with NA=0.20.

Q.4 **(a)** Discuss the LASER diode principle, modes and threshold conditions. **07**

(b) Answer the following questions: **07**

1 Describe the extrinsic absorption and bending losses in optical fiber.

2 List out the principal requirements of a good connector design.

OR

Q.4 **(a)** Write detail note on: Types of receiver preamplifiers **07**

(b) Answer the following questions: **07**

1 Explain the working principle of PIN photo diode.

2 The quantum efficiency of a particular silicon avalanche photodiode is 80% for the detection of radiation at a wavelength of 0.9 μm. When the incident optical power is 0.5 μW, the output current from the device (multiplied photocurrent) is 11 μA. Determine the multiplication factor M of the photodiode.

Q.5 **(a)** List out the key system requirements needed in analyzing a point-to point link. Discuss the link power budget in the design of an optical link. **07**

(b) Write brief note on: **07**

1 Semiconductor optical amplifiers

2 Operating principle of an optical time-domain reflectometer (OTDR).

OR

Q.5 **(a)** Write detail note on synchronous optical network (SONET) **07**

(b) Write brief note on: **07**

1 DWDM

2 Phase-Array-Based WDM devices

****