

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– VI (NEW) EXAMINATION – WINTER 2021****Subject Code:2161005****Date:04/12/2021****Subject Name:Optical Communication****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) Define terms with respect to optical fiber cables: (1) Snell's law (2) Critical angle and (3) Normalized frequency. **03**
- (b) Compare Single Mode Fibers and Multi- Mode fibers. Also draw refractive index profiles for step index and graded index cables. **04**
- (c) With help of neat block diagram describe working principle of the optical communication systems. Also list out various advantages of use of the optical fiber communication systems. **07**

- Q.2** (a) Compare LED and LASER with respect to their merits and demerits as an optical source in the working of optical fiber communication systems. **03**
- (b) Write short note on Dispersion effects observed in optical signals. **04**
- (c) Define term scattering loss related optical signal. Also describe (1) Rayleigh Scattering (2) Mie Scattering effects in detail. **07**

OR

- (c) Enlist different lensing schemes used in optical communication system and briefly explain them. **07**

- Q.3** (a) Describe in brief about Star optical couplers. **03**
- (b) Given a core half-width $a = 1.55 \mu\text{m}$, a wavelength of the ray $\lambda = 1.55 \mu\text{m}$, $n_1 = 5/3$ and $n_2 = 2\sqrt{2}/3$, Calculate the values of Δ and the NA parameter of the given cable. **04**
- (c) A photodiode is constructed of GaAs, which has a band-gap energy of 1.43 eV at 300 K. Find out cut off wave length over which GaAs photodiode will not operate. In a 100-ns pulse, 6×10^6 photons at a wavelength of 1300 nm thrown on an InGaAs photodetector. On the average 3.9×10^6 electron-hole (e-h) are generated. Calculate the quantum efficiency of such InGaAs photodetector. **07**

OR

- Q.3** (a) Mention the procedure to calculate link power Rise time budget. **03**
- (b) When the mean optical power launched into an 8 km length of fiber is $120 \mu\text{W}$, the mean optical power at the fiber output is $3 \mu\text{W}$. Determine:
 (a) the overall signal attenuation or loss in decibels through the fiber assuming there are no connectors or splices.(b) the signal attenuation per kilometer for the fiber.(c) the overall signal attenuation for a 10 km optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1 dB. **04**

- (c) Photons of energy 1.53×10^{-19} J are incident on a photodiode which has a responsivity of 0.65 A/W. If the optical power level is $10 \mu\text{W}$, Calculate the amount of photocurrent could be generated. An InGaAs *pin* photodiode has the following parameters at a wavelength of 1300 nm: $I_D = 4 \text{ nA}$, $\eta = 0.65$, $RL = 1000\Omega$, and the surface leakage current is negligible. The incident optical power is 300 n W (- 35 dBm) and the receiver bandwidth is 20 MHz, Estimate the values of various noise terms of the given *pin* photodiode. **07**
- Q.4** (a) Only list out various fiber splicing techniques. **03**
 (b) Define the following terms with respect to optical coupler: (1) Excess loss (2) Insertion loss and (3) Crosstalk. **04**
 (c) Explain Optical Time Domain Reflectometry (OTDR) method in detail, which is used in optical communication system. **07**
- OR**
- Q.4** (a) Differentiate optical connector and optical splicer. **03**
 (b) Mention significance of EYE diagram usage in the working of optical communication systems. **04**
 (c) Describe in details about Synchronous optical fiber networks (SONET). **07**
- Q.5** (a) Write short note on EDFA. **03**
 (b) Describe briefly working of the distributed feedback LASER. **04**
 (c) Describe the need of OADM, optical circulators, wavelength - converter and OTDR in optical communication link. **07**
- OR**
- Q.5** (a) Write short note on RAMAN amplifier. **03**
 (b) Describe LASER action with three key transient processes. **04**
 (c) With help of neat diagram explain the working of a typical WDM link. Also list out features of the WDM system. **07**
