

#### B. TECH (SEM V) THEORY EXAMINATION 2021-22 OPTICAL COMMUNICATION

Time: 3 Hours

Total Marks: 100

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

### SECTION A

### 1. Attempt *all* questions in brief.

- a. Define acceptance angle and numerical aperture.
- b. Explain normalized frequency (V) value in a multimode and single mode optical fiber.
- c. Classify different types of nonlinear scattering in an optical fiber.
- d. Differentiate between electrical and optical bandwidth using frequency response curve.
- e. Explain the importance of double hetereo-junction structures in an optical source.
- f. Plot the effect of temperature on the avalanche gain of a photodiode.
- g. Define receiver sensitivity and quantum limit.
- h. Define Intrinsic and extrinsic absorption in an Optical Fiber.
- i. Formulate the condition of minimum Gain in Fabry-Perot Cavity to sustain Oscillation.
- j. Define Stimulated emission.

#### SECTION B

### 2. Attempt any *three* of the following:

- a. Find out the relationship between acceptance angle and refractive indices of core, cladding and medium for a light ray incident on the fiber core. Calculate the Numerical aperture of step index fiber having core refractive index of 1.56 and cladding refractive index as 1.40.
- b. Define attenuation. Consider a 30 km long optical fiber working at wavelength ( $\lambda$ ) of 130 nm and has an attenuation of 0.4dB/km, find out the output optical power if 200 $\mu$ W of optical power is launched into the fiber.
- c. Define population inversion. Also Derive the threshold condition for laser oscillations to sustain.
- d. Explain the possible noise sources in a photodiode. Also explain quantum noise in detail.
- e. Discuss Free space optics (FSO) based communication systems.

## SECTION C

## 3. Attempt any *one* part of the following:

- (a) Classify optical fibers on the basis of number of modes and core refractive index profile.
- (b) A multimode step index fiber with core diameter of 70μm, relative refractive index difference of 1.7% is operating at a wavelength of 0.85μm. If the core refractive index is 1.48, Estimate (i) Normalized frequency (ii) Number of Guided Modes.

## 4. Attempt any *one* part of the following:

- (a) Determine the rms pulse broadening ( $\sigma_s$ ) due to intermodal dispersion in terms of core refractive index ( $n_1$ ), cladding refractive index ( $n_2$ ) and the length of fiber for a multimode step index fiber. A 6 km optical link consists of multimode step index fiber with a core refractive index of 1.5 and a relative refractive index difference of 1 %. Estimate the delay difference between the slowest and fastest modes.
- (b) Explain the bending losses in an optical fiber, also calculate the critical radius of curvature for a multimode fiber with a core refractive index of 1.8, a relative refractive index difference of 4 % and an operating wavelength of 0.82μm.

# $10 \times 1 = 10$

 $10 \ge 1 = 10$ 



 $2 \times 10 = 20$ 

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 $10 \ge 3 = 30$ 

#### 5. Attempt any *one* part of the following:

- Explain Fabry Perot resonating cavity. A ruby laser contains a crystal of length 5cm (a) with a refractive index of 1.67. The peak emission wavelength from the device is 0.65 μm. Determine the no of longitudinal modes and their frequency separation.
- Explain S-LED and E-LED structures with the help of proper diagram. (b)

**Roll No:** 

#### 6. Attempt any one part of the following:

- Explain principle, construction and working of p-i-n diode. Discuss the factors which (a) limit the speed of response of a photodiode.
- Discuss the requirements of an ideal photo detector; also explain the construction and (b) working of avalanche photodiode.

#### 7. Attempt any one part of the following:

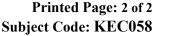
- Discuss Eye pattern features in an optical communication, also comment on ISI using (a) Eye diagram.
- Illustrate Power Penalty in an optical communication. Also explain different types of (b) Power Penalties.



 $10 \ge 1 = 10$ 

#### $10 \ge 1 = 10$

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