Subject Code: KEC058

PAPER ID-410356

Roll No: | | | | | | | | | | | | | |

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. 2 x 10 = 20

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: 10 x 3 = 30

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 (λ) of 130 nm and has an attenuation of 0.4dB/km, find out the output optical power if 200μW 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: 10 x 1 = 10

(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: 10 x 1 = 10

(a) Determine the rms pulse broadening (σ_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.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain Fabry Perot resonating cavity. A ruby laser contains a crystal of length 5cm 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.

(b) Explain S-LED and E-LED structures with the help of proper diagram.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain principle, construction and working of p-i-n diode. Discuss the factors which limit the speed of response of a photodiode.

(b) Discuss the requirements of an ideal photo detector; also explain the construction and working of avalanche photodiode.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Discuss Eye pattern features in an optical communication, also comment on ISI using Eye diagram.

(b) Illustrate Power Penalty in an optical communication. Also explain different types of Power Penalties.