Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**

PET7J008

7th Semester Regular / Back Examination 2019-20

OPTICAL COMMUNICATION NETWORKING

BRANCH : ECE, ETC

Max Marks : 100

Time : 3 Hours

Q.CODE : HRB127

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Differentiate between acceptance angle and critical angle using neat sketch?

b) Define the phase and group velocity of monochromatic light with suitable diagram.

c) What do you mean by group velocity dispersion?

d) Illustrate the difference between single mode and multimode optical fiber.

e) A beat length of 15 cm is observed in a typical single mode fiber, when light of 1 μm is launched into it. Calculate the modal birefringence.

f) Define the mode-field diameter (MFD) in a single-mode fiber and indicate how this parameter relates to the spot size?

g) A digital fiber optic link operating at 1420 nm, requires a maximum BER of 10.8 Calculate the required averaged photons per pulse.

h) How emission and absorption of radiation for LASER diode take place?

i) What is the material used for the fabrication of sources having operating wavelength in the range of 0.8-0.9μm?

j) A p-n photodiode has quantum efficiency of 50 % at λ=0.92μm.Calculate the responsivity at this wavelength.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Describe the main constituents of an optical fiber communication link with suitable block diagram.

b) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.48 and a cladding refractive index of 1.45. Determine :

(a) the critical angle at the core–cladding interface

(b) the NA for the fiber

(c) acceptance angle in air for the fiber.

c) What do you mean by skew rays? An optical fiber in air has an NA of 0.4, calculate the acceptance angle for skew rays which change direction by 100°at each reflection.

d) What do you understand from normalized frequency (V) in optical fiber? How is the normalized frequency (V) is related to the radius of the core in optical fiber? What is the value for a single mode to exist?

e) Derive the expression for the wave equation of an electromagnetic wave propagating through optical fiber using Maxwell's equation.

f) What is Rayleigh scattering? Mention the factors that cause Scattering losses.

g) A silicon p–i–n photodiode has a quantum efficiency of 65% at a wavelength of 0.8 μm. Determine:

(a) The mean photocurrent when the detector is illuminated at a wavelength of 0.8 μm with 5 μW of optical power

(b) The rms quantum noise current in a post-detection bandwidth of 20 MHz

h) If the relative refractive index difference is 1.2% and core refractive index is 1.50, and operating wavelength 0.76μm then calculate the maximum core diameter for single mode operation when the relative refractive index difference is reduced by a factor of ten.

i) Consider a 10 Km long multimode fiber where the core refractive index of 1.50, cladding refractive index of 1.47, Δ=0.01. Find out the maximum pulse broadening for the total length of the optical fiber.

j) With a schematic diagram explain the structure of Fabry-Perot resonator cavity. Define resonant frequency of the cavity.

k) With suitable diagram explain the configuration of ELED. Also draw the typical spectral patterns for ELED and SLED at 1310 nm.

l) A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident upon it. Find
(a) At what wavelength is the photodiode operating?
(b) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 What are the types of optical fiber based on variation of refractive Index? With a clear sketch compare the different fiber types based on the following points **(16)**
a) Refractive index profile
b) Fiber cross section and ray paths
c) Typical dimensions.

Q4 **a)** What are the two main causes of intramodal dispersion in optical waveguides? Explain group delay during the propagation of the optical signal. **(8)**

b) A multimode guided index fiber exhibit total pulse broadening of 0.1 μsec over the distance of 15 km. Determine **(8)**
(a) Maximum possible bandwidth on link assuming no inter symbol interference,
(b) Pulse dispersion per unit length,
(c) Optical bandwidth Length product.

Q5 **a)** Discuss absorption losses in optical fibers. Comparing and contrasting the intrinsic and extrinsic absorption mechanism. **(8)**

b) Describe the optical receiver operation and its performance using appropriate diagram. **(8)**

Q6 **Writes short notes on the following :** **(8 x 2)**
a) Evanescent field
b) SLED