EEC-701 **Roll No.** | | | | | | | | | | |

B.Tech.

(SEM VII) ODD SEMESTER THEORY EXAMINATION, 2015-16

OPTICAL COMMUNICATION

Time: 3 Hours *Maximum Marks:100*

Note: *Attempt all questions.*

Q1. Attempt any four parts of the following: 5x4=20

(a) List the advantages, disadvantages and the application of optical fiber communication.
(b) Discuss the significance of LP modes?
(c) Define normalized frequency for an optical fiber and explain its use in the determination of number of guided modes propagating with in a step index fiber.
(d) A step index multi-mode fiber with a numerical aperture of 0.20 supports approximately 1000 modes at an 850 nm wavelength.What is the diameter of its core? How many modes does the fiber support at 1550 nm?
(e) Derive wave equation for step index fiber and derive the condition for single mode fiber propagation.
(f) Discuss the criterion for selecting fiber materials. Name two Glass fiber used in optical communication. Describe Vapor Phase Axial deposition method of fiber fabrication with the help of block diagram.

Q2. Attempt any four parts of the following: 5x4=20

(a) Discuss the following type of losses.

(i)Bending loss

(ii)Scattering losses.

(ii) Discuss the significance of group velocity. Explain Chromatic Dispersion with mathematical support.
(iii) A glass fiber exhibits material dispersion given by $|\lambda^2(d^2n_1/d\lambda^2)|$ of 0.025.Determine the material dispersion parameter at a wavelength of 0.85 μm and estimate the rms pulse broadening per km for a good LED source with an rms spectral width of 20 nm at this wavelength.
(iv) Explain with support of figures various Mechanical Misalignments and different jointing techniques.
(v) Calculate External Quantum efficiency at the surface of LED.
(vi) Discuss Cut Back Method test with suitable block diagram.

Q3. Attempt any two parts of the following: 10x2=20

(a) Discuss the working of Fabry Perot Cavity Resonator diode. Explain edge emitter LEDs with relevant diagram.
(b) Derive LASER diode Rate equation. Photons of energy $1.53x10^{-19}$ J are incident on a photodiode which has a responsivity of 0.65 A/W.If optical power level is 10 μW,find the photo current generated.
(c) Discuss the principle and working of DFB LASERs.The 3 –dB frequency of an LED is desired to be 30 MHz.Find its modulation bandwidth.

Q4. Attempt any Two parts of the following: 10x2=20

(a) Discuss degeneration mechanism in Injection lasers. A Gallium arsenide injection laser with a cavity of length 400 μm has a loss coefficient of 20 cm^{-1}.The measured differential external quantum efficiency of the device is 55%.Calculate the internal quantum efficiency of the laser. The refractive index of Gallium arsenide is 3.6.

(b) Derive principle noises associated with photo detector and their significance. If the photo diode capacitance is 3pf, the amplifier capacitance is 5pf, the load resistance is 1 kΩ and the amplifier input resistance is 1 MΩ. What is the circuit bandwidth.

(c) Find out the probability of error for digital optical receiver. Explain the relevance of Eye diagram? Derive the BER for PSK Heterodyne System.

Q5. Attempt any Two parts of the following: 10x2=20

(a) Explain the significance of Receiver Sensitivity and quantum limit. With the help of suitable diagram explain how the information regarding the signal amplitude distortion, timing jitter and system rise time can be determined.

(b) Explain Sub Carrier Multiplexing(SCM) and Multichannel Frequency Modulation.

(c) Discuss various components of digital fiber optic link.A digital fiber optic link has to be designed to transmit at a data rate of 20 Mb/s with a BER of 10^{-9} using NRZ code.The devices have the following parameters

(i) A GaAlAs LED emitting at 850nm can couple an average 100 μW of optical power into a fiber of 50 μm core diameter.

(ii) The fiber is graded index type having α =2.5 dB/Km, t_{mat} = 3 ns/Km,t_{mod} = 1 ns/Km

(iii) A silicon p-i-n photo diode has been used for the receiver with sensitivity = -42 dBm.

(iv) The source rise time is 12 ns.

(v) Receiver rise time is 11 ns.

(vi) The cable has to be spliced at every Km with a loss of 0.5 dB/splice

(vii) There are two connectors one at transmitter and the other at the receiver with a loss of 1 dB each.

(viii) Assume a safety margin of 6 dB.Estimate the maximum possible link length without repeaters and the total rise time of the system.