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Total Number of Pages: 1

M.TECH
ETPE105

1st Semester Regular/Back Examination – 2014

FIBRE OPTICS COMPONENTS & DEVICES

BRANCH(S): COMMUNICATION ENGINEERING, COMMUNICATION SYSTEMS, ELECTRONICS & COMMUNICATIONS ENGINEERING, ELECTRONICS & TELE COMMUNICATION ENGINEERING

Time: 3 Hours

Max Marks: 70

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.



- Q1 Answer the following questions: (2x10)
- a) Why is singlemode fiber less costly than multimode fiber?
 - b) A photodiode has a capacitance of 10 pF. Calculate the maximum load resistance which allows 10 MHz post detection bandwidth.
 - c) Why do you need to clean fiber optic connectors?
 - d) Write the expression for angular misalignment and explain the term?
 - e) Draw the equivalent circuit for digital optical fiber receiver including the various noise sources.
 - f) Define fiber splicing.
 - g) Compare p-n Photodiode with p-i-n Photodiode.
 - h) The Fresnel reflection at a butt joint with an air gap in a multimode step index fiber is 0.49 dB. Find the refractive index of the core.
 - i) Define Meridional ray and skew ray.
 - j) What is Population inversion and Optical pumping?
- Q2 a) How are the following elements constructed? Explain their role in WDM networks. (5)
- (i) Multilayer dielectric thin-film filters.
 - (ii) Mach-Zehnder interferometers.
- b) With the help of a block diagram explain the operational principles of WDM. (5)
- Q3 a) Explain the mechanism of intermodal dispersion in a multimode step index fiber. (5)
- b) A pin photo diode on average generates one electron hole pair per incident photons at a wavelength of 0.8 μm . Assuming all the electrons are collected calculate (5)
- (i) the quantum efficiency of the device.
 - (ii) its maximum possible band gap energy.
 - (iii) the mean output photo current when the received optical power is 10^{-4} W.
- Q4 a) Explain with the necessity diagram the different types of fiber structures. (5)
- b) An InGaAs pin photodiode has the following parameters at a wavelength of 1600 nm: $I_D = 5$ nA, $\eta = 0.9$, $R_L = 2\text{k}\Omega$ and the surface leakage current is negligible. The incident optical power is 300 nW and the receiver bandwidth is 20 MHz. Find the various noise terms of the receiver. (5)
- Q5 Derive the expression for different noise sources in an optical receiver. (10)
- Q6 a) What are the different types of optical fiber couplers and explain their working? (5)
- b) Explain the impact ionization and avalanche effect in the avalanche photodiodes (APD). (5)
- Q7 a) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.6 and cladding refractive index of 1.46. Determine: (5)
- (i) The critical angle at the core cladding interface.
 - (ii) The numerical aperture for the fiber.
 - (iii) The acceptance angle in air for the fiber.
- b) Explain the different types of bending losses in optical fibers. (5)
- Q8 Describe any TWO from the following (5+5)
- a) Passive optical couplers
 - b) Laser diode structures
 - c) OTDM
 - d) Integrated Optics
 - e) Fusion Splices