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P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Fifth Semester, B.E. - Electronics and Communication Engineering
Semester End Examination; Dec - 2017/Jan - 2018
Optical Communication Systems

Time: 3 hrs   *Max. Marks: 100*

Note: *i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume missing data suitably.

UNIT - I

1 a. Compare conventional single mode and multimode step index and graded index optical fibers with neat diagrams. Mention the advantages and disadvantages between them. | 7

b. Consider three multimode step index optical fibers, each of which has a core index of 1.48 and index difference $\Delta = 0.01$. Assume the three fibers have core diameters of 50, 62.5 and 100 µm. What are the numbers of modes in these fibers at a wavelength of 1550 nm? | 6

c. Define Bending Losses. Explain macrobending and microbending in detail with neat diagrams. Also explain Power Coupling to higher order modes in microbending. | 7

2 a. With neat diagram, explain Spot size and Mode field diameter in Single mode fibers. | 5

b. Define Acceptance angle. Develop an expression for Numerical aperture and acceptance angle in case of Step index fibers. | 8

c. Briefly explain Material dispersion and Polarization mode dispersion with neat diagrams. | 7

UNIT - II

3 a. Explain the Laser diode modes and Threshold considerations with neat diagrams. | 7

b. Explain Fiber splicing and types of splicing techniques with neat diagrams. | 8

c. A double hetero junction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non-radiative recombination times of 30 ns and 100 ns respectively. The drive current is 40 mA. Find;

   i) The bulk recombination time

   ii) The internal quantum efficiency

   iii) The internal power level. | 5

4 a. With neat diagram, explain the working of Surface Emitting LED. | 8

b. A GaAs laser operating at 850 nm has a 500 µm length and a refractive index $n = 3.7$;

   i) What are the frequency spacing and the wavelength spacing?

   ii) If, at the half-power point, $\lambda - \lambda_0 = 2$ nm, what is the spectral width σ of the Gain? | 6

c. Discuss with sketches, the different lensing schemes used to improve the optical source to fiber coupling efficiency. | 6

UNIT - III

5 a. Explain the working of Reach-through photo diode structure.   8

  b. Explain the Eye diagram with neat diagram to show the fundamental measurements parameters.   7

  c. An InGaAs pin photodiode has the following parameters at a wavelength of 1300 nm: $I_D = 4$ nA, $\eta = 0.90$, $R_L = 1000$ Ω and the surface leakage current is negligible. The incident optical power is 300 nW and the receiver bandwidth is 20 MHz. Find the primary photocurrent and mean-square short noise current.   5

6 a. Define SNR of photodetector noise. Explain photodetector receiver with its circuit diagram and its mathematical model.   8

  b. With the help of circuit diagram, describe the working of a trans impedance amplifier.   5

  c. Briefly explain digital signal transmission indicating the signal path through an optical data link at each stage with neat diagram.   7

UNIT - IV

7 a. Develop the expression for the total rise time of the optical digital link.   7

  b. With neat diagram, explain the characteristics of 2 x 2 waveguide coupler.   5

  c. Explain the following :

    i) Multichannel AM   ii) Subcarrier multiplexing.   8

8 a. Discuss the basic constituents of a generic RF over Fiber link.   6

  b. Briefly explain optical isolators and optical circulators with necessary diagrams.   6

  c. With neat diagram, explain the formation of Fiber Bragg Grating by means of two intersecting ultraviolet light beams. Also get the expression for fraction of optical power in fiber core.   8

UNIT - V

9 a. With simplified energy level diagram, discuss the amplification mechanisms and various transition process of EDFA.   8

  b. Explain with diagrams and transmission rate table, the basic structure of STS-1 SONET frame, STS-N SONET frame and STM-N SDH frame.   12

10 a. Describe briefly the Inline optical amplifiers, preamplifiers, power amplifiers and LAN signal booster with neat diagrams.   8

  b. Explain the network topologies of basic optical fiber network with neat diagrams.   6

  c. Briefly discuss the optical cross connect architecture using optical source switches and wavelength connectors.   6

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