18/4/13

B.E. / B.TECH (FULL TIME) DEGREE ARREAR EXAMINATIONS, APRIL / MAY 2013

ELECTRONICS AND COMMUNICATION ENGINEERING BRANCH

SEVENTH SEMESTER REGULATIONS : 2008

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EC 9402 - OPTICAL COMMUNICATION

Time: 3 Hours **Answer ALL Questions** **Max.marks: 100**

Part-A (10x2=20 Marks)

1. What is the condition for a mode to remain guided in an optical fiber.
2. What are the mechanisms that give rise to signal attenuation in optical fibers.
3. Find the core radius necessary for single mode (HE_{11}) operation at 1320 nm of a step index fiber with $n_1 = 1.48$ and $n_2 = 1.478$.
4. What are Dispersion Compensating Fibers.
5. What are the advantages of Quantum Well laser diodes over conventional DH laser diodes.
6. Compare the two LED structures.
7. Obtain the relationship between Quantum efficiency and Responsivity of photodiodes.
8. What are the advantages of transimpedance preamplifiers.
9. Calculate the transmission bit rate of the basic SONET (STS-1) signal.
10. How semiconductor laser diodes are different from semiconductor optical amplifiers.

Part-B (5x16=80 Marks)

11.(i) Draw the block diagram of an optical fiber communication link and indicate all the major elements. **(4)**

(ii) Compare with refractive index profiles n(r), the two optical fiber structures. **(4)**

(iii) With necessary diagrams, explain one method of fiber fabrication. **(8)**

12.(a)(i) Discuss briefly the dispersion mechanisms in Multimode optical fibers. **(10)**

(ii) A 5 km optical link consists of Multimode Step Index fiber with a core refractive index of 1.49 and Δ of 1%. Find the delay difference at the fiber output between the slowest and fastest modes. Compare the rms pulse broadening caused by intermodel dispersion of the above SI fiber with that of GI fiber with optimum index profile. **(6)**

OR

12.(b)(i) Write a short note on "Profile Dispersion". **(6)**

(ii) Briefly discuss about the major non-linear optical effects that contribute to signal impairment in silica fibers. **(10)**

13.(a) Briefly explain the three transition processes taking place in semiconductor lasers. Derive the threshold condition in Fabry Perot resonator cavity laser diodes. Hence obtain the frequency spacing $\Delta\gamma$ of the longitudinal modes. **(16)**

OR

13.(b)(i) Calculate the peak emission wavelength of a DH $Ga_{1-x}Al_xAs$ LED with x = 0.1. If the radiative and non-radiative recombination life times of the minority carriers in the active region with refractive index of 3.6 are 60 ns and 100 ns respectively. Determine the total carrier recombination life time and the power internally generated within the device at a drive current of 40 mA. Also calculate the optical power emitted into air. What are the optical and electrical 3dB bandwidths of the LED source. **(8)**

(ii) With a diagram explain the laser transmitter arrangement having external modulation for free space optical communication. **(8)**

14.(a)(i) Explain the operation of an Avalanche Photo Diode. **(8)**

(ii) An InGaAs PIN photo diode has the following specifications at 1550 nm; I_D = 1.0 nA; η = 0.95; R_L = 500 Ω and the surface leakage current is negligible. The incident optical power is 500 nw and the receiver bandwidth is 150 MHz. Calculate and compare the associated noise currents. **(8)**

OR

14.(b)(i) With mathematical expressions, explain the rise time budget that is carried out in optical fiber digital links. **(8)**

(ii) Using necessary diagram, explain the concept of coherent detection of optical signals. **(8)**

15.(a)(i) Briefly discuss about SONET / SDH rings. **(10)**

(ii) Explain the principle of operation of a polarization independent isolator. **(6)**

OR

15.(b)(i) With energy band diagram, explain the light amplification mechanism in Erbium Doped Fiber. With diagrams discuss the EDFA architectures. **(10)**

(ii) With a diagram of a 2x2 optical fiber coupler, define the parameters of optical couplers that characterizes the performance of couplers. **(6)**
