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R 3324

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Seventh Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1402 — OPTICAL COMMUNICATION

(Common to B.E. (Part–Time) Sixth Semester Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the relationship between rays and modes

2. A silica optical fiber has a core refractive index of 1.5 and a cladding refractive index of 1.47. Determine the acceptance angle in air for the fiber.

3. What do you mean by polarization mode dispersion?

4. Distinguish dispersion shifted and dispersion flattened fibers

5. What do you mean by heterojunction? Mention its advantages.

6. List the different types of mechanical misalignments that can occur between two joined fibers.

7. What are the desired features of a photodetector?

8. Define quantum limit.

9. What are the advantages of WDM?

10. Distinguish fundamental and higher order solitions.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain with a neat diagram the elements of an optical fiber transmission link. (10)

(ii) A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85 μm. If the core refractive index is 1.48, estimate the normalized frequency for the fiber and the number of guided modes. (6)

Or

(b) (i) Discuss the evolution of fiber optic communication system. (6)

(ii) Sketch and explain the electric field distribution of the lower order guided modes in symmetrical slab waveguide. (6)

(iii) Draw the structures of step index and graded index fibers with their typical dimensions. (4)

12. (a) (i) When the mean optical power launched into an 8 km length of fiber is 120 μW, the mean optical power at the fiber output is 3 μW. Determine

(1) Overall signal attenuation in dB/Km and

(2) The overall signal attenuation for a 10 km optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1 dB. (6)

(ii) Explain with suitable diagrams the different mechanisms that contribute to attenuation in optical fibers. (10)

Or

(b) (i) Discuss in detail intramodal dispersion with relevant expressions and diagrams. (10)

(ii) Write a brief note on design optimization of single mode fibers. (6)

13. (a) (i) Draw and explain the LED structures based Double Hetero structure configuration. (8)

(ii) Discuss the principle of operation of Laser diodes. What are the effects of temperature on the performance of a laser diode? (8)

Or

(b) (i) Explain the different lensing schemes available to improve the power coupling efficiency. (8)

(ii) Explain the fiber splicing techniques with necessary diagrams. (8)

14. (a) (i) A silicon p-i-n photodiode incorporated into an optical receiver has a quantum efficiency of 60% at a wavelength of 0.9 μm. The dark current is 3 nA and load resistance is 4 KΩ. The incident optical power is 200 nw and the receiver bandwidth is 5 MHz. Determine

(1) mean square quantum noise current,

(2) mean square dark current and

(3) mean square thermal noise current at a temperature of 20°C. (8)

(ii) Draw and explain the operation of APD. (8)

Or

(b) (i) Discuss the different noise sources and disturbances in the optical pulse detection mechanism. (6)

(ii) Derive an expression for the bit error rate of an optical digital receiver. (10)

15. (a) Explain the significance of link power budget and rise time budget with one illustration for each. (16)

Or

(b) (i) Explain the principle of operation of Erbium doped fiber amplifier. (10)

(ii) Give a brief account of the principles of SONET. (6)