KUMARAGURU
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Register Number: ……..

B.E DEGREE EXAMINATIONS: NOV 2015

(Regulation 2009)

Seventh Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE120: Optical Communication

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. A ray of light is passed from a silica glass of refractive index 1.48 to another silica glass of refractive index 1.46. What is the range of angles (measured with respect to the normal to the interface) for which this ray will undergo total internal reflection?

   a) 0°–80° b) 81°–90°

   c) 90°–180° d) 180°–360°

2. Light is guided within the core of a step-index fiber by

   a) refraction at the core–air interface. b) total internal reflection at the core–cladding interface.

   c) total internal reflection at the outer surface of the cladding. d) change in the speed of light within the core.

3. Which of the following refractive index profiles is suitable for achieving the dispersion-flattened design of a single-mode fiber?

   a) Matched cladding b) Triangular profile

   c) W-profile d) Depressed cladding

4. Which of the following fibers are suitable for wavelength-division multiplexing of signals?

   a) Dispersion-optimized b) Dispersion-shifted

   c) Dispersion-flattened d) Any fiber

5. In an LED, which of the following factors affects most severely the efficiency of the diode and cannot be eliminated even in principle?

   a) Fresnel reflection b) Back emission

   c) Total internal reflection d) Absorption

6. Which of the following pairs are suitable for making a heterojunction?

a) Si and Ge
b) Si and GaAs
c) GaAs and AlAs
d) GaAs and GaAlAs

7. Which of the following detectors give amplified output?
a) p-n photodiode
b) p-i-n photodiode
c) Avalanche photodiode
d) Photovoltaic detector

8. Which of the following is an inherent property of an optical signal and cannot be eliminated even in principle?
a) Thermal noise
b) Shot noise
c) Environmental noise
d) Background noise

9. The function of wavelength-division multiplexer is to
a) separate signals at different wavelengths and couple them to different detectors.
b) combine signals at different wavelengths to pass through a single fiber.
c) tap off part of the energy of the incoming signal.
d) change the transmission speed of the input signal.

10. Fiber Bragg gratings cannot be used for the following measurement.
a) Pressure
b) Liquid level
c) Strain
d) Temperature

PART B (10 x 2 = 20 Marks)

11. What is the necessity of cladding for an optical fiber?
12. What is the principle used in the working of fibers as light guides?
13. Mention the three different mechanisms which cause absorption.
14. What is the significance of group delay.
15. Why silicon is not used to fabricate LED or Laser diode?
16. What are the characteristics needed for an LED to be used in fiber transmission?
17. Define response time and list the factors that influence the response time of a photo diode.
18. What are the drawbacks of Avalanche photo diode?
19. What are the basic performance criteria of the WDM?
20. Distinguish fundamental and higher order solitons.

PART C (5 x 14 = 70 Marks)

21. a) (i) A typical relative refractive index difference for an optical fiber designed for long distance transmission is 1%. Estimate the *NA* and the solid acceptance angle in air for the fiber when the core index is 1.46. Further, calculate the (7)

critical angle at the core–cladding interface within the fiber. It may be assumed that the concepts of geometric optics hold for the fiber.

(ii) What are the functions of the core and cladding in an optical fiber? Why should their refractive indices be different? Would it be possible for the light to be guided without cladding? (7)

(OR)

b) (i) Discuss the materials and effects of doping concentration of the materials used for refractive index variation. (7)

(ii) A multimode step index fiber with a core diameter of 80µm 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: (a) the normalized frequency for the fiber; (b) the number of guided modes. (7)

22. a) Describe the fiber structures utilized to provide (i) dispersion-shifting and (ii) dispersion-flattening in single-mode fibers.

(OR)

b) (i) Discuss in detail the phenomenon of modal noise in optical fibers and suggest how it may be avoided. (8)

(ii) Write notes on various factors & effects of dispersion in optical fibers. (6)

23. a) A GaAs LED is forward-biased with a current of 120 mA and a voltage of 1.5 V. Each emitted photon possesses an energy of 1.43 eV, and the refractive index of GaAs is 3.7. The configuration of the LED is such that we may neglect back emission and self-absorption within the semiconductor. Assuming the internal quantum efficiency of the LED to be 60%, calculate (i) the internal power efficiency of the device and (ii) the external power efficiency of the device.

(OR)

b) The energy bandgap for lightly doped gallium arsenide at room temperature is 1.43 eV. When the material is heavily doped (degenerative) it is found that the lasing transitions involve ‘bandtail’ states which effectively reduce the bandgap transition by 8%. Determine the difference in the emission wavelength of the light between the lightly doped and this heavily doped case.

24. a) The avalanche photodiode and the photo conducting detector both provide gain. Compare their merits for use in optical communication and other applications.

(OR)

b) (i) Explain about the operation of optical receiver system. (7)

(ii) What are the design constraints of preamplifier of optical receiver system? (7)

25. a) Explain in detail about link power budget & rise time budget with an example?

(OR)

b) (i) Explain the modularity and scalability features of an optical network. (6)

(ii) What is the importance of optical amplifiers. Explain the principle of operation of optical amp. (8)

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