SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE
SEMBODAI-614 809

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BE ECE IV YEAR VII SEMESTER- 2008 REGULATION

EC2402 OPTICAL COMMUNICATION AND NETWORKING

PREVIOUS YEAR UNIVERSITY QUESTION PAPERS

Reg. No. : | | | | | | | | | | | |

Question Paper Code : 55349

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2011.

Seventh Semester

Electronics and Communication Engineering

EC 2402 — OPTICAL COMMUNICATION AND NETWORKING

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Missing data could be suitably assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the energy of a single photon of the light whose λ = 1550 nm, in eV?

2. Assume that there is a glass rod of refractive index 1.5, surrounded by air. Find the critical incident angle.

3. Define the attenuation coefficient of a fiber.

4. Calculate the cut-off wavelength of an optical signal through a fiber with its core refractive index of 1.50 and that of cladding = 1.46. The core radius of 25 μm. The normalised frequency is 2.405.

5. Why silicon is not used to fabricate LED or Laser diode?

6. Calculate the external differential quantum efficiency of a laser diode operating at 1.33 μm. The slope of the straight line portion of the curve for the emitted optical power P versus drive current I is given by 15 mW/mA.

7. Define 'quantum efficiency' of a photo detector and write the expression.

8. Mention the error sources in fiber optic receiver.

9. What are the three common topologies used for fiber optical network? Give the schematic of any one network?

10. Calculate the number of independent signals that can be sent on a single fiber in the 1525-1565 nm band. Take the spectral spacing as per ITU-T recommendation G.692.

PART B — (5 × 16 = 80 marks)

11. (a) (i) What is numerical aperture of an optical fiber? Deduce an expression for the same. (12)

(ii) Calculate NA of silica fiber with its core refractive index (n_1) of 1.48 and cladding refractive index of 1.46. What should be the new value of 'n_1' in order to change the NA to 0.23. (4)

Or

(b) (i) Explain the phenomenon of total internal reflection using Snell's law with figures and calculations. (12)

(ii) Distinguish step-index from graded index fibers. (4)

12. (a) (i) What do you mean by pulse broadening? Explain its effect on information carrying capacity of a fiber. (12)

(ii) An LED operating at 850 nm has a spectral width of 45 nm. What is the pulse spreading in ns/km due to material dispersion? What is the pulse spreading when a laser diode having a 2 nm spectral width is used? The material dispersion is 90 ps/nm km. (4)

Or

(b) (i) What is meant by 'fiber splicing'? Explain fusion splicing of optical fibers. (8)

(ii) Explain expanded beam fiber connector with a neat schematic. (8)

13. (a) (i) Compare LED with a laser diode. (4)

(ii) With the help of a neat diagram explain the construction and working of a surface emitting LED. (12)

Or

(b) (i) Explain the structure and working of a silicon APD. (12)

(ii) Define S/N ratio of a photodetector. What conditions should be met to achieve a high SNR? (4)

14. (a) (i) Explain the fiber optic receiver operation using a simple model and its equivalent circuit. (8)

(ii) Explain the operation of a pre-amplifier buit using a FET. (8)

Or

(b) Explain the measurement technique used in the ase of

(i) Numerical aperture

(ii) Refractive index profile

(iii) Fiber cut-off wave length

(iv) Fiber diameter. (16)

15. (a) Explain the architecture of SONET and discuss n onlinear effects on Network performance. (16)

Or

(b) Write short notes on

(i) Wavelength routed networks. (8)

(ii) Optical CDMA. (8)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20274

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Seventh Semester

Electronics and Communication Engineering

EC 2402 /EC 72/10144 EC 702— OPTICAL COMMUNICATION AND NETWORKING

(Regulation 2008)

(Common to PTEC 2402 – Optical Communication and Networking for B.E. (Part – Time) Sixth Semester Electronics and Communication Engineering Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The relative refractive index difference (Δ) for an optical fiber is 1%. Determine the critical angle at the core cladding interface if the core refractive index is 1.46

2. A step index fiber has a normalized frequency (V) of 26.6 at 1300 nm. if the core radius is 25 μm, find the numerical aperture.

3. A 30 km long optical fiber has an attenuation of 0.8 dB/km. If –7 dBm of optical power is launched into the fiber, determine the output optical power in dBm.

4. What factors cause Rayleigh scattering in optical fibers?

5. What are the advantages of LED?

6. Photons of energy 1.53×10^{-19} J are incident on a photodiode which has a responsivity of 0.65 A/W. If the optical power level is 10 μW, find the photocurrent generated

7. Define quantum limit.

8. What are the methods used to measure fiber refractive index profile?

9. Write the functions of transport and path overhead.

10. What are the drawbacks of broadcast and select networks for wide area network applications?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw and explain the acceptance angle and numerical aperture of an optical fiber and derive expressions for both. (8)

(ii) A fiber has a core radius of 25 μm, core refractive index of 1.48 and relative refractive index difference (Δ) is 0.01. If the operating wavelength is 0.84 μm, find the value of normalized frequency and the number of guided modes. Determine the number of guided modes if Δ is reduced to 0.003. (8)

Or

(b) (i) Draw and explain the refractive index profile and ray transmission in single mode and multimode step index fibers and graded index fibers. Write the expressions for the numerical aperture and number of guided modes for a graded index fiber. (8)

(ii) A step index fiber has a core diameter of 7 μm and core refractive index of 1.49. Estimate the shortest wavelength of light which allows single mode operation when the relative refractive index difference for the fiber is 1%. (8)

12. (a) Explain the following with necessary diagram and expressions

(i) Non linear scattering loss and fiber bend loss. (10)

(ii) Material dispersion in optical fiber. (6)

Or

(b) (i) Explain mechanical splices with neat diagrams. (8)

(ii) Write a brief note on fiber alignment and joint loss. (8)

13. (a) (i) Draw and explain surface and edge emitting LEDs. (8)

(ii) Explain any two injection laser structures with neat diagrams. (8)

Or

(b) (i) Explain the operation of APD with neat diagram. (8)

(ii) A silicon p-i-n photodiode incorporated into an optical receiver has a quantum efficiency of 60% when operating at a wavelength of 0.9 μm. The dark current in the device is 3 nA and the load resistance is 4 KΩ. The incident optical power is 200 nW and the post detection bandwidth of the receiver is 5 MHz. Calculate the root mean square (rms) shot noise and thermal noise currents generated. (8)

14. (a) (i) Discuss the noise and disturbances affecting the optical detection systems. (6)

(ii) Draw and explain the operation of high impedance FET and BJT preamplifiers. (10)

Or

(b) Explain the following measurements

(i) Attenuation measurement using cut back techniques. (8)

(ii) Frequency domain measurement of fiber dispersion. (8)

15. (a) Explain the principle of solitons and discuss the soliton parameters with necessary expressions and diagrams. (16)

Or

(b) Write short notes with necessary diagrams on :

(i) Optical CDMA. (8)

(ii) WDM and EDFA system performance. (8)

Anna University

Question Paper code : 11347

B.E./B.Tech. Degree Examination, November/December 2012

Seventh Semester

Electronics and Communication Engineering

EC 2402/EC 72/10144 EC 702 - Optical Communication and Networking

(Regulation 2008)

(Common to PTEC 2402 - Optical Communication and Networking for B.E. (Part-Time) Sixth Semester Electronics and Communication Engineering - Regulation 2009)

Time: Three hours

Maximum : 100 marks

Answer ALL questions

Part A - (10 * 2 = 20 marks)

1. Calculate the cutoff wavelength of a single mode fiber with core radius of 4μm and $\Delta = 0.003$.

2. For a fiber with core refractive index of 1.54 and fractional refractive index difference of 0.01, calculate its numerical aperture.

3. What are the two reasons for chromatic dispersion?

4. What are the most important non-linear effects of optical fiber communication?

5. Compare and contrast between surface and edge emitting LEDs.

6. What is the significance of intrinsic layer in PIN diodes?

7. What is dark current?

8. List out the various error sources.

9. What were the problems associated with PDH networks?

10. Enumerate the various SONET/SDH layers.

Part B - (5 * 16 = 80 marks)

11. (a) (i) Starting from the Maxwell's equation, derive the expression for the wave equation of an electromagnetic wave propagating through optical fiber.

(8 marks)

11. (a) (ii) Derive the ray theory behind the optical fiber communication by total internal reflection. State the application of Snell's law in it.

(8 marks)

Or

11. (b) (i) A Si fiber with silica core refractive index of 1.458, v = 75 and NA = 0.3 is to be operated at 820nm. What should be its core size and cladding refractive index? Calculate the total number of modes entering this fiber.

(8 marks)

11. (b) (ii) Derive expression for the linearly polarized modes in optical fibers and obtain the equation for V number.

(8 marks)

12. (a) (i) Describe the linear and non-linear scattering losses in optical fibers.

(8 marks)

12. (a) (ii) An LED operating at 850nm has a spectral width of 45mm. What is the pulse spreading in ns/km due to material dispersion? What is the pulse spreading when a laser diode having a 2nm spectral width is used?

(8 marks)

Or

12. (b) (i) Draw and explain the various fiber alignment and joint losses.

(8 marks)

12. (b) (ii) Write notes on fiber splices and connectors.

(8 marks)

13. (a) Draw and explain the structure of Fabry-Perot resonator cavity for a laser diode. Derive laser diode rate equations.

(16 marks)

Or

13. (b) (i) Draw the structure and electric fields in the APD and explain its working.

(8 marks)

13. (b) (ii) What are the three factors that decides the response time of photodiodes? Explain them in detail with necessary sketches.

(8 marks)

14. (a) (i) Draw the front end optical amplifiers and explain.

(8 marks)

14. (a) (ii) Considering the probability distributions for received logic 0 and 1 signal pulses, derive the expressions for BER and error function.

(8 marks)

Or

14. (b) Write notes on the following

(i) Fiber refractive index profile measurement

(8 marks)

(ii) Fiber cut off wavelength measurement

(8 marks)

15. (a) discuss the concepts of Media Access Control protocols in Broadcast and select networks.

(16 marks)

Or

15. (b) (i) Describe the non-linear effects on network performance in detail.

(8 marks)

15. (b) (ii) Explain the basics of optical CDMA systems.

(8 marks)

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Question Paper Code : 21377

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Seventh Semester

Electronics and Communication Engineering

EC 2402/EC 72 — OPTICAL COMMUNICATION AND NETWORKING

(Common to PTEC 2402 – Optical Communication and Networking for B.E. (Part-Time) Sixth Semester – Electronics and Communication Engineering – (Regulation 2009))

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. For $n_1 = 1.55$ and $n_2 = 1.52$, calculate the critical angle and Numerical aperture.
2. What is a Linearly polarized mode?
3. What is Rayleigh scattering?
4. What is meant by mechanical splice?
5. Calculate the band gap energy for an LED to emit 850 nm.
6. Define : Detector response time.
7. What are the error sources of receiver?
8. What is known as quantum limit?
9. What is a broadcast and select network?
10. What is a soliton?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Derive the mode equations for a circular fibre using Maxwell's equations. (8)

(ii) Calculate the Numerical Apertures of a fibre having $n_1 = 1.6$ and $n_2 = 1.49$ and another fibre having $n_1 = 1.458$ and $n_2 = 1.405$. Which fibre has greater Acceptance angle? (8)

Or

(b) (i) Explain the ray theory of a fibre with a special mention about TIR, Acceptance angle and NA. (8)

(ii) Describe Single mode fibres and their mode – field diameter. What are the propagation modes in them? (8)

12. (a) (i) Derive expressions for material dispersion and waveguide dispersion and explain them. (8)

(ii) Describe the various types of fiber connectors and couplers. (8)

Or

(b) (i) Explain fiber alignment and joint losses. (6)

(ii) Describe various fiber splicing techniques with their diagrams. (10)

13. (a) (i) Draw the structures of SLED and ELED and explain their principle of operation. (8)

(ii) Draw the injection laser diode structure and explain lasing in it. (8)

Or

(b) (i) Draw the structures of PIN and APD photo detectors and explain their operations. (8)

(ii) Derive expressions for the SNR of both PIN and APD by incorporating all noise sources. (8)

14. (a) What are the various types of Preamplifiers available for optical networks? Explain any three of them with their circuit diagrams. (16)

Or

(b) Write detailed notes on the following :

(i) Fibre refractive index profile measurement (8)

(ii) Fibre cut off wavelength measurement (8)

15. (a) (i) Explain the SA/SA protocol and modified SA/SA protocol of Broadcast and select networks. (8)

(ii) What are the non – linear effects on network performance? Explain them briefly. (8)

Or

(b) (i) Explain the layered architecture of SONET/SDH with neat diagram. (8)

(ii) Write a detailed notes on optical CDMA and its applications. (8)

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Question Paper Code : 31377

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Seventh Semester

Electronics and Communication Engineering

EC 2402/EC 72/10144 EC 702 – OPTICAL COMMUNICATION AND NETWORKING

(Regulation 2008/2010)

(Common to PTEC 2402 – Optical Communication and Networking for B.E. (Part-Time) Sixth Semester – Electronics and Communication Engineering – (Regulation 2009))

Time : Three hours | Maximum : 100 marks

Missing data may be suitably assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The refractive indexes of the core and cladding of a silica fiber are 1.48 and 1.46 respectively. Find the acceptance angle for the fiber.
2. Determine the normalized frequency at 820 nm for a step-index fiber having a 25 μm radius. The refractive indexes of the cladding and the core are 1.45 and 1.47 respectively. How many modes propagate in this fiber at 820 nm?
3. A continuous 12 kms-long optical fiber link has a loss of 1.5 dB/km. What is the minimum optical power that must be launched into the fiber to maintain an optical power level of 0.3 μW at the receiving end?
4. Define dispertion in multimode fibers. What is its effect?
5. Write two differences between a Laser diode and a LED.
6. For a photodiode define quantum efficiency- η and responsivity - R.
7. A digital fiber optic link operating at 1310 nm, requires a maximum BER of 10^{-8}. Calculate the required average photons per pulse.
8. The photo detector output in a cutback-attenuation set up is 3,3 V at the far end of the fiber. After cutting the fiber at the near end, 5m from the far end, photo detector output read was 3.92 V. What is the attenuation of the fiber in dB/Km?

9. Obtain the transmission bit rate of the basic SONET frame in Mbps.

10. Illustrate interchannel cross talk that occurs in a WDM system.

PART B — (5 × 16 = 80 marks)

11. (a) (i) With the help of a block diagram explain the different components of a optical fiber link. (12)

(ii) Compare the optical fiber link with a satellite link. (4)

Or

(b) (i) Explain the differences between meridional and skew rays. (4)

(ii) Bring out the differences between phase and Group velocities. (6)

(iii) Deduce an expression for NA of a fiber with the help of a neat figure showing all the details. (6)

12. (a) (i) Discuss the attenuation encountered in optical fiber communication due to :

(1) Bending

(2) Scattering

(3) Absorption. (12)

(ii) Calculate the maximum transmission distance for a fiber link with an attenuation of 0.2 dB/Km if the power launched in 1mw and the receiver sensitivity is 50 μW. Calculate the attenuation for an other link with same parameters and the distance of 26 Kms. (4)

Or

(b) (i) Clearly bringout the differences between intra and inter modal dispersion. (12)

(ii) Find the maximum bit rate for the fiber link of 5 Kms. The numerical aperture is 0.25 and the refractive index is 1.48. (4)

13. (a) (i) Explain the working of n hetero structure LED. (10)

(ii) Define Internal quantum efficiency of a LED. Deduce the expression for the same. (6)

Or

(b) (i) What do you understand by optical-wave-confinement and current confinement in LASER diode? Explain with suitable structures. (10)

(ii) Briefly explain the different noise sources of a photo detector. (6)

14. (a) (i) Explain any two types of preamplifiers used in a receiver. (12)

(ii) Define the terms – 'Quantum limit' and 'Probability of Error' with respect to a receiver with typical values. (4)

Or

(b) (i) Explain the 'Insertion-Loss method' used for attenuation measurement. (8)

(ii) Explain the technique used in 'Frequency – Domain Intermodal Dispersion measurement'. (8)

15. (a) (i) What is a 'four-fiber BLSR' ring in a SONET? Explain the reconfiguration of the same during node or fiber failure. (8)

(ii) What is 'broadcast-and-select multihop network'? Explain. (8)

Or

(b) (i) Explain the following requirements for the design of an optically amplified WDM link :

(1) Link Band width

(2) Optical power requirements for a specific BER. (8)

(ii) Write a note on solitons. (8)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 51417

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Seventh Semester

Electronics and Communication Engineering

EC 2402/EC 72/10144 EC 702 — OPTICAL COMMUNICATION AND NETWORKING

(Regulation 2008/2010)

(Common to PTEC 2402 – Optical Communication and Networking for B.E. (Part –Time) Sixth Semester – Electronics and Communication Engineering– (Regulation 2009))

Time : Three hours Maximum : 100 marks

Missing data may be suitably assumed

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A multimode fibre has core diameter of 50 μm and cladding refractive index of 1.45. If its modal dispersion is 10 ns/km, find its numerical aperture.
2. Distinguish meridional rays from skew rays.
3. Identify the causes of scattering loss.
4. A fibre has an attenuation of 1.5 dB/Km at 1300 nm. If 0.5 mW of optical power is initially launched into the fibre, what is the power level in microwatts after 9Km?
5. If the absorption coefficient of silicon is 0.05 micrometer^{-1} at 860 nm, find the penetration depth at which $p(x)/P_{in} = 0.368$.
6. Define the internal quantum efficiency of LED.
7. What are the receiver error sources?
8. Describe the term 'Quantum limit.
9. List out the benefits of SONET over PDH networks.
10. Give the significance of solitons.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw and explain ray theory transmission in an optical communication. (8)

(ii) With diagram, explain acceptance angle, numerical aperture and total internal reflection. (8)

Or

(b) With diagram, explain electromagnetic mode theory of optical propagation. (16)

12. (a) Explain the attenuation and losses in fibre. (16)

Or

(b) With diagram, explain intra and inter modal dispersion. (16)

13. (a) With diagram, explain surface and edge emitters of LED structures. (16)

Or

(b) Draw and compare the construction and characteristics of PIN and Avalanche photo diode.. (16)

14. (a) With suitable diagram, explain optical receiver operation and its performance. (16)

Or

(b) Describe the dispersion and numerical aperture measurements of fibre. (16)

15. (a) Explain SONET layers and frame structure with diagram. (16)

Or

(b) With suitable example, explain the conditions and constraints in the formulation and solution of routing and wavelength assignment problem in an optimal way. (16)