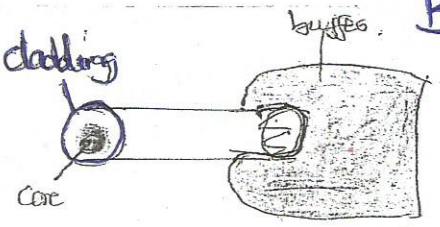
BENG10T BEATRICE KAIENDE



SECTION A

QUESTION ONE

a) Discus at least four advantages of optic fiber cables versus metallic cables. ***(4 Marks)***

b) Define index profile. Mention two types of index profile you know. ***(3 Marks)***

c) Describe two specification which must be considered when specifying optical cables ***(2Marks)***

d) Choose the most appropriate answer to the following questions ***(5 Marks)***

i. What does 125 refer to when written 62.5/125/250?
(a) 125 µm diameter of the core (b) 250 µm diameter of the cladding (c) 250 µm sheath diameter (d) no answer

ii. Loose-tube cable is used where
(a) ease of termination is a concern (b) high pulling strength is required
(c) high flexibility is a concern (d) several fibers must fit in a small space.

iii. Which among the following is not optical fiber transmission band according to ITU
(a) S-band (b) C-band (c) E-band (d) K-band

O-band
E-band
S-band
C-band
L-band
U-band.

iv. Loss of light power is called
(a) dBm (b) attenuation (c) absorption (d) diffusion

v. A non-conductive optical fiber cable for use in an air-handling plenum would be labeled
(a) OFNP (b) OFCP (c) OFNR (d) OFCR.

(e) Match the word(s) listed with the correct description in the right column. ***(6 Marks)***

(i) Fusion splicing	(a) contains single and multimode fibers
(ii) Extrinsic loss	(b) temporary connection
(iii) Connector	(c) data communication
(iv) Intrinsic loss	(d) contamination
(v) Graded-index multimode	(e) core eccentricity
(vi) Hybrid cable	(f) permanent connection

12(13, 14, 15)

SECTION B

QUESTION TWO

a) With the aid of diagram describe the three layers of basic optical fiber. ***(5 Marks)***

b) Figure 1 shows the basic block diagram of optical fiber communication link. Redraw it and replace A, B, and C with the correct terms. Describe the function of block A, B, and C. ***(5 Marks)***

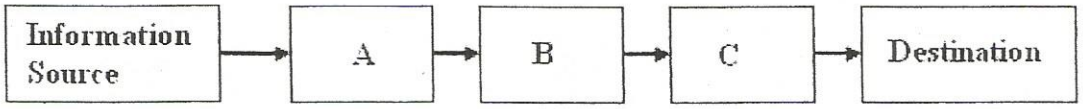


Fig. 1 Optical fiber communication system

c) Explain four major reasons for fiber joints. ***(4 Marks)***

d) What is the difference between Intrinsic and Extrinsic losses? Give two examples for each. ***(6 Marks)***

QUESTION THREE

a) Describe at list four primary characteristics of light detectors. ***(4 Marks)***

b) A multimode step index fiber has a glass core with a refractive index (n_1) = 1.5 and a fused quartz cladding with a refractive index (n_2) = 1.46. If the source-to-fiber media is air, calculate: ***(12 Marks)***

i. the critical angle (Q_c);

ii. the acceptance angle (Q_{in});

iii. the numerical aperture (NA).

c) Briefly describe at least three installation specifications of optic fiber cable.***(4 Marks)***

QUESTION FOUR

a) Define the following as far as optical fiber system link budget is concern; ***(8 Marks)***

i. Link power budget
ii. Link loss budget
iii. Receiver sensitivity
iv. Link loss margin

b) Determine the optical power received in dBm and watts for a 24-km optical fiber link with the following parameters: ***(12 Marks)***
LED output power of 20 mW
Six, 4-km sections of optical cable each with a loss of 0.6 dB/km

Three cable-to-cable connectors with a loss of 2.1 dB each
No cable splices
Light source-to-fiber interface loss of 2.2 dB
Fiber-to-light detectors loss of 1.8 dB
No losses due to cable bends.

QUESTION FIVE

a) Describe with the aid of simple ray diagrams: ***(4 Marks)***
   i. the multimode step index fiber;
   ii. the single mode step index fiber.
b) Discuss at least two advantages and two disadvantages of SM and MM types of fiber for use as an optical channel. ***(8 Marks)***
c) A 3 μm diameter single mode optical fiber has a core and cladding indexes of refraction of 1.545 and 1.510 respectively. Determine the cut off wavelength for the fiber to transmit single mode. ***(8Marks)***

QUESTION SIX

(a) State the two major categories of fiber–fiber joint. Indicating the difference between them. **(5 *Marks)***
(b) Define Fresnel reflection with respect to fiber optic. Indicate how it may be avoided. **(5 *Marks)***
(c) A silica multimode step index fiber has a core refractive index of 1.46. Determine the optical loss in decibels due to Fresnel reflection at a fiber joint with: ***(10 Marks)***
   i) a small air gap;
   ii) an index-matching epoxy which has a refractive index of 1.40.

It may be assumed that the fiber axes and end faces are perfectly aligned at the joint.

Benson Michael

DAR ES SALAAM INSTITUTE OF TECHNOLOTY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Tutorial Questions

Module : Fiber Optic Communications
Class : BEng 10 T

QUESTION ONE

Discus at least four advantages of optic fiber cables versus metallic cables.

QUESTION TWO

For the light entering the fiber from free space, show how the Numerical Aperture (NA) of optical fiber is related to both core and cladding refractive indexes

QUESTION THREE

Match the type of cable listed with description in the right column.

(i) Zipcord cable	(a) contains single and multimode fibers
(ii) Tightpack cable	(b) two fibers, tight-buffered, mostly used for patch cords
(iii) Breakout cable	(c) contains copper conductors and optical fiber
(iv) Loose-tube cable	(d) distribution cables
(v) Composite cable	(e) a small diameter, high-fiber count cable
(vi) Hybrid cable	(f) several simplex units cabled together

QUESTION FOUR

Using simple ray theory, describe the mechanism for the transmission of light within an optical fiber. Briefly discuss with the aid of a suitable diagram what is meant by the acceptance angle for an optical fiber. Show how this is related to the fiber numerical aperture and the refractive indices for the fiber core and cladding. An optical fiber has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Determine:

(a) the acceptance angle for the fiber in water which has a refractive index of 1.33;
(b) the critical angle at the core–cladding interface.
Comment on any assumptions made about the fiber.

QUESTION FIVE

Explain what is meant by a graded index optical fiber, giving an expression for the possible refractive index profile. Using simple ray theory concepts, discuss the transmission of light through the fiber. Indicate the major advantage of this type of fiber with regard to multimode propagation.

QUESTION SIX

Define the normalized frequency for an optical fiber and explain its use in the determination of the number of guided modes propagating within a step index fiber.

A step index fiber in air has a numerical aperture of 0.16, a core refractive index of 1.45 and a core diameter of 60 μm. Determine the normalized frequency for the fiber when light at a wavelength of 0.9 μm is transmitted. Further, estimate the number of guided modes propagating in the fiber. 23.5 , 56

QUESTION SEVEN cabling – process of packaging optical fibers in cable structure for handling and protection. protect in hazardous environment,

Briefly describe the major reasons for the cabling of optical fibers which are to be placed in a field environment. Thus state the functions of the optical fiber cable.

- telecoms (telephone and the internet
- LAN (Backbone
- cable TV (voice, video, internet connect
- security (CCTV and intrusion sensors
- utilities (management of power grids)

QUESTION EIGHT

Discuss optical fiber cable design with regard to:

(a) fiber buffering;

(b) cable strength and structural members;

(c) layered cable construction;

(d) cable sheath and water barrier.

QUESTION NINE

fiber splices
simple term
fixed and non fixed

State the two major categories of fiber–fiber joint, indicating the differences between them. Briefly discuss the problem of Fresnel reflection at all types of optical fiber joint, and indicate how it may be avoided.

A silica multimode step index fiber has a core refractive index of 1.46. Determine the optical loss in decibels due to Fresnel reflection at a fiber joint with:

(a) a small air gap; 0.31 dB

(b) an index-matching epoxy which has a refractive index of 1.40. 3.8×10^{-4} dB

It may be assumed that the fiber axes and end faces are perfectly aligned at the joint.

$L_t = \frac{2}{\pi}\left(\frac{y}{a}\right)\left(\frac{\alpha+2}{\alpha+1}\right)$ *

QUESTION TEN

$\alpha = \infty$

y = offsets

a = radius

Describe the three types of fiber misalignment which may contribute to insertion loss at an optical fiber joint.

A step index fiber with a 200 μm core diameter is butt jointed. The joint which is index matched has a lateral offset of 10 μm but no longitudinal or angular misalignment. Using two methods, estimate the insertion loss at the joint assuming the uniform illumination of all guided modes. 0.29 dB.

Lateral, angular, imperfect surface finish

$IL = -10\log(1 - L_t)$

fixed (splice)

$L_t = \frac{2}{\pi}\cdot\left(\frac{y}{a}\right)\cdot\left(\frac{\alpha+}{\alpha+1}\right)$

α - graded index

$L_t = \frac{2}{\pi}\left(\frac{y}{a}\right)$

$\eta_{at} = 1 - L_t$

Inser loss $= -10\log_{10} 2L_t$

Reasons for cabling of optical fiber

- mechanical protection for the fibers
- make them easier to handle.
- provide protection against environment hazards.

Function of optic fibre

1. convert electrical input signal into optical signal
2. send the output signal over an optical fiber
3. convert an optical signal back to an electrical signal.

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATIONS ENGINEERING

TEST 1
BENG 10 T
FIBER OPTIC COMMUNICATION

TIME: 45 MINUTES **DATE: MAY 14, 2013**

Student Particulars

NAME	VICTOR SULEIMAN
ADM. No.	100602 8212
CLASS	BENG 810T
SCORE (Under 40)	34

Instructions

1. This paper consists of **FOUR** questions, Attempt all questions.
2. Write the most correct answer in the provided box/blanks on this question paper.
3. Do your rough work on separate sheet given to you as a rough paper.
4. Write in Black/Blue ink and draw diagrams in pencil.
5. Write clearly.
6. Phones are not allowed in the examination room.

QUESTION ONE *(10 Marks)* 08/10

Choose the most appropriate answer to the following questions

1. Confining light in a material by surrounding it by another material with lower refractive index is the phenomenon of

   (a) diffraction (b) total internal reflection (c) total internal refraction (d) transmission [d] (1)

2. The main advantage(s) of optical fibers is (are) its ability to _____ than other transmission media.

   (a) transport more information (b) transport information faster (c) transport information farther (d) all of the above [d] (1)

3. What does 250 refer to when written 100/140/250 μm?

   (a) 250 μm core diameter (b) 250 μm cladding diameter (c) 250 μm sheath diameter [c] (1)

4. In graded-index optical fiber, the index profile approximates a parabola. The benefit of this is

   (a) reduced bandwidth (b) reduced cross-talk (c) increased modal dispersion (d) reduced modal dispersion. [d] (1)

5. Which among the following is not an intrinsic loss

   (a) core eccentricity (b) core ellipticity (c) core diameter mismatch (d) poor cleave. [d] (1)

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QUESTION TWO ***(10 Marks)***

Match the terms in right column with appropriate terms in left column.

(i) Minimum recommended installation bend radius	d	(a) resistance to water damage
(ii) Minimum long-term bend radius	f	(b) OFCP
(iii)Plenum rated	b	(c) rodent resistance
(iv) Self support" cable	e	(d) no less than 20 times the diameter of the cable
(v) Environment specification	a	(e) cable designed for long-term use loads
(vi) "Filled and blocked" cable	e	(f) no less than 10 times the diameter of the cable
(vii) Fusion splicing	g	(g) permanent fiber connection
(viii) Armored cable	j	(h) temporary fiber connection
(ix) Installation specification	i	(i) diameter of the cable
(x) Connector	h	(j) resistance to damage from water

QUESTION THREE ***(9 Marks)***

Match the type of cable listed with the best description in the right column.

(i) Zipcord cable	c	(a) contains single and multimode fibers
(ii) Graded-index MM cable	d	(b) long-distance telecommunications
(iii) Tightpack cable	f	(c) two fibers, tight-buffered, mostly used for patch cords
(iv) SM cable	g	(d) efficient source power coupling
(v) Breakout cable	i	(e) contains copper conductors and optical fiber
(vi) Loose-tube cable	h	(f) distribution cables
(vii) Step-index MM cable	d	(g) long-distance telecommunications
(viii) Composite cable	e	(h) a small diameter, high-fiber count cable
(ix) Hybrid cable	a	(i) several simplex units cabled together

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QUESTION FOUR *(11 Marks)* 11/11

An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular (to the core axes) end faces are butted together. Assuming the fiber axes are perfectly aligned, calculate the optical loss in decibels at the joint (due to Fresnel reflection) when there is a small air gap between the fiber end faces.

Given $n_1 = 1.5$

$n = 1$ (air)

Loss = ?

Solution

$$r = \left[\frac{n_1 - n}{n_1 + n}\right]^2 \quad (1)$$

$$r = \left[\frac{1.5 - 1}{1.5 + 1}\right]^2$$

$$r = 0.04 \quad (3)$$

$$\text{Loss} = -10 \log(1 - r) \text{ dB} \quad (1)$$

$$= -10 \log_2 (1 - 0.04)$$

$$= 0.1773 \times 2$$

$$= 0.35 \text{ dB}$$

$$\therefore \text{Loss} = 0.3 \text{ dB} \quad (6)$$

Benson Michael. BEATRICE KATENDE SH

Videolum 2009

DAR ES SALAAM INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION
SEMESTER II TEST
B.ENG 06 T

Optic fiber communications

TIME: 2 HOURS June 9, 2009.

1. (a) Define the following terms as related to optic fiber communications

(i) Cladding **(1mark)**
(ii) Refraction **(1mark)**
(iii) Refractive index **(1mark)**
(iv) Total Internal Reflection **(1mark)**
(v) Mode field Diameter **(1mark)**

(b) If the light is trying to emerge from glass with n_1=1.5 into air (n_2=1), what will be the critical angle θ_c. **(2marks)**

2 (a) (i) Define index profile **(1mark)**
(ii) What are types of index profile? **(1mark)**
(iii) What are the causes, effects and solutions to modal dispersion? **(1 ½ marks)**

(b) What is the difference between Intrinsic and extrinsic loses? **(1 ½ marks)**

3 (a) What are the main sources of extrinsic loss? **(2 ½ marks)**

(b) What are the main sources of intrinsic loss? **(2 ½ marks)**

4. Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(3marks)**

5. (a) Given that the input wavelength is 1449 nm and the Raman shift is 12.2THz, what is the wavelength of the scattered optical wave? What is the amount of the wavelength shift? **(3 marks)**

(b) Consider a piece of step-index optical fiber with a refractive index at the fiber core of 1.47 and a fractional refractive index change for the core and the cladding of 0.02.
(i) What should be the maximum fiber core diameter if this fiber is designed to be single mode for wavelength starting from 1100nm? **(2 ½ marks)**

(ii) Estimate the number of modes if the fiber used for 850nm laser **(2 ½ marks)**.

DAR ES SALAAM INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

2ND SEMESTER TEST I

B-Eng 07T

Optic fiber communications

TIME: 1 ½ hrs

DATE: 23rd April, 2010.

Instructions:

1. Do all questions

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1(a) Draw a block diagram of optic fiber communication link and describe the function of each block **(5marks)**

(b) Mention four advantages of optic fiber over other transmission medium **(2marks)**

2.(a) Define (i) Optic fiber communications **(1mark)**
(ii) Cladding **(1mark)**
(iii) Refraction **(1mark)**
(iv) Refractive index **(1mark)**
(v) Total Internal Reflection **(1mark)**
(vi) Mode field Diameter **(1mark)**
(vii) Define index profile **(1mark)**

(b) Describe types of index profile? **(2mark)**

3.(a)) If the light is trying to emerge from glass with n_1=1.5 into air (n_2 =1), what will be the critical angle θ_c **(1marks)**

(b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(3marks)**

4.Consider a multimode fiber with a core diameter of 100 μm, core refractive index of 1.475 and a cladding refractive index of 1.455 both at 850 nm. Consider operating this fiber at λ = 850 nm.

Calculate (i) /estimate the number of modes. **(1marks)**

(ii) The core diameter beyond which the fiber becomes single mode. **(1marks)**

(iii) Calculate the maximum acceptance angle **(1mark)**

5. Consider a piece of step-index optical fiber with a refractive index at the fiber core of 1.47 and a fractional refractive index change for the core and the cladding of 0.02.
(a) What should be the maximum fiber core diameter if this fiber is designed to be single mode for wavelength starting from 1100nm? **(1marks)**
(b) Estimate the number of modes if the fiber used for 850nm laser. **(1marks)**

DAR ES SALAAM INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

2nd SEMESTER TEST I

B-Eng 08T
Optic fiber communications

TIME: 1:40 hrs

DATE: 18th May, 2011.

Instructions:

1. Do all questions

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1. (a) Draw a block diagram of optic fiber communication link and describe the function of each block **(4marks)**

   (b) Mention four advantages of optic fiber over other transmission medium (2marks)

2. (a) Define (i) Optic fiber communications **(1mark)**
   (ii) Cladding **(1mark)**
   (iii) Refraction **(1mark)**
   (iv) Refractive index **(1mark)**
   (v) Total Internal Reflection **(1mark)**
   (vi) Mode field Diameter **(1mark)**
   (vii) Define index profile **(1mark)**

   (b) Describe types of index profile? **(2mark)**

3. (a) If the light is trying to emerge from glass with n_1=1.5 into air (n_2 =1), what will be the critical angle θ_c (1marks)
   (b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(4marks)**

4. (a) Describe the two types of intramodal (chromatic) dispersion. **(2 marks)**

   (b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(4 marks)**

5. (a) Give brief a description of Multimode fiber **(3marks)**

   (b) Consider a multimode fiber with a core diameter of 100μm , core refractive index of 1.475 and a cladding refractive index of 1.455 both at 850 nm . Consider operating this fiber at $\lambda = 850$ nm .

   Calculate (i) Estimate the number of modes. **(2marks)**
   (ii) The core diameter beyond which the fiber becomes single mode. **(3marks)**
   (iii) Calculate the maximum acceptance angle. **(2marks)**

6. A 2-km-length multimode fiber has a modal dispersion of 1 ns/km and a chromatic dispersion of 100 ps/km • nm. If it is used with an LED of line width 40 nm, (a) what is the total dispersion? (b) Calculate the bandwidth (BW) of the fiber **(4 marks)**.

BW

$1\ ns/km \times 2km = 2ns$ $disp_1 = 2ns$

$disp_2 = 100 \times 10^{-12} \times 2 = 0.2\ ns$

$C = \lambda f$

$\lambda = c$

DAR ES SALAAM INSTITUTE OF TECHNOLOGY
ELECTRONICS AND TELECOMMUNICATION ENGINEERING
SEMESTER II NTA Level 8 EXAMINATION
B.Eng 05T AII

ET 425: FIBER OPTIC COMMUNICATION

TIME: 3 HOURS **DATE:** June, 2008

Instructions

1. Follow all instructions written on your answer booklet
2. This paper consists of two sections, (A and B). Section A has TEN (10) questions; section B has FIVE (5) questions. Attempt all questions in section A, and any THREE (3) questions in section B.
3. You are not allowed to write anything in the question paper
4. Write in black/blue ink and draw diagrams in pencil
5. Write clearly
6. Phones are not allowed in the examination rooms

SECTION A [40%]

QUESTION NO. 1 [4 marks]

a. Define fiber optics → branch of optical technology concerned with the transmission of radiant power through fibre
b. Describe the basic functions of a fiber optic data link - convert electrical input signal to optical signal
- convert optical signal back to elec
c. What are the two basic types of optical fibers? [single mode, multimode]
d. Define loss as applied to optic fiber
— decrease in the amount of light reaching the end of fibre

QUESTION NO. 2 [4 marks]

Explain the cause of **Rayleigh scattering** phenomenon. **[4 marks]**

QUESTION NO. 3 [4 marks]

a. What effect does noise have on the fiber optic signal? reduces the signal strength.
b. What mechanisms in the fiber waveguides weaken and distort the optical signal? Scattering, Absorption, dispersion.

QUESTION NO. 4 [4 marks]

a. How can loss be reduced during construction (or fabrication) of optical fibers? by removing the impurities from optical fiber
b. Name at least four advantages of fiber optics over electrical systems
overall system economy, greater information capacity, crosstalk immunity, signal security, Emmune switch electrical isolation

QUESTION NO. 5 [4 marks]

An important distinguishing feature of different types of optical fiber is the normalized frequency (V) and number of modes (N). What are the four parameters which affect the value of V?

$V = \frac{2\pi a}{\lambda} NA$ — a = diameter of the core

$N_{mode} = \frac{V^2}{2}$ or $\frac{V^2}{4}$

QUESTION NO. 6 [4 marks]

a. Light traveling through a waveguide will be subjected to distortion. The emitted light will be spread out in time. In the field of fiber optics this is called dispersion. Mention the two types of dispersion. modal, chromatic
b. What condition causes a light ray to be totally reflected back into its medium of propagation?

QUESTION NO. 7 [4 marks]

a. What fiber property does numerical aperture (NA) measure? (measures the light gathering ability of an optical fibre
b. Attenuation is mainly a result of what three properties?
- Absorption loss,
- material loss or Rayleigh
- coupling loss
- modal dispersion
- chromatic dispersion

QUESTION NO. 8 [4 marks]

a. Mention three fiber properties to be adjusted in order to maximize the system bandwidth? NA, index profile, Core diameter
b. Name the two types of chromatic dispersion [material, waveguide]

QUESTION NO. 9 [4 marks]

Mention at least four measurements that can be done using OTDR

QUESTION NO. 10 [4 marks]

a. Modes of a light pulse that enter the fiber at one time exit the fiber at different times. This condition causes the light pulse to spread. What is this condition called?
b. Micro-bend loss is caused by microscopic bends of the fiber axis. List three sources of micro-bend loss. – external force
– improper cabling procedure
– uneven coated applies

SECTION B [60%]

QUESTION NO. 11 [20 marks]

a. What are the three major elements of an optical fiber transmission link? **(6 marks)** Tx, Rx and fiber
b. Draw a well labeled block diagram showing how the major elements of **optical fiber transmission link** are interconnected **(14 marks)**

QUESTION NO. 12 [20 marks]

a. Clearly explain the difference between step index and the graded index fibers.
b. 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 0.85μm. If the core refractive index is 1.48, estimate:
   i. The normalized frequency for the fiber
   ii. The number of guided modes

QUESTION NO. 13 [20 marks]

a. Consider an optical fiber with the following parameters: graded index profile (g) =2, Core diameter=2a=50μm, Numerical aperture NA =0.2 at λ 20 μm.
   Calculate the value of Normalized frequency (V)
b. Draw a well labeled diagram of under sea optical fiber cable **(15 marks)**

QUESTION NO. 14 [20 marks]

a. What are the differences between SONET and SDH **(4 marks)**

b. With the aid of a block diagram, explain the *Digital transmission hierarchy used in North American telephone Network* **(16 marks)**

QUESTION NO. 15 [20 marks]

a. For a variety of applications, such as long-haul transmission systems with Erbium Doped Amplifiers (EDFA) and systems for wavelength division multiplexing it is necessary to shift the point of zero dispersion to other wavelengths. What is the name of the fiber with this characteristic? **(5marks)** modal dispersion

b. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5 and cladding refractive index of 1.47. Determine:

i. The critical angle at the core cladding-interface **(5marks)**
ii. The Numerical Aperture (NA) for the fiber **(5marks)**
iii. The acceptance angle in air for the fiber **(5marks)**

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DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SEMESTER II EXAMINATION

B.Eng 06T

ET 425 : Fiber Optic communication

TIME: 3 Hours July, 2009

1.Follow all instructions written on your answer booklet

2. This paper consists of sections A and B. Section A has ONE (1) question, section B has SIX (6) questions. Attempt question one in section A, and any FOUR (4) questions in section B. All questions in section B carry equal marks.
3. You are not allowed to write anything in the question paper
4. Write in black/blue ink and draw diagrams in pencil
5. Write clearly
6. Phones are not allowed in the examination room

Section A:

1. (a) Define the following terms as related to optic fiber communications

   (i) Cladding **(1mark)**
   (ii) Refraction **(1mark)**
   (iii) Refractive index **(1mark)**
   (iv) Total Internal Reflection **(1mark)**
   (v) Mode field Diameter **(1mark)**

   (b) (i) Define index profile **(1mark)**
   (ii) What are types of index profile? **(1mark)**
   (iii) What are the causes effects and solutions to modal dispersion? **(1 ½ marks)**

   (c) (i) What is the spectral width of a light source? **(1mark)**
   (ii) What is the difference between Intrinsic and extrinsic loses? **(1 ½ marks)**
   (iii) If the light is trying to emerge from glass with n_1=1.5 into air (n_2 =1), what will be the critical angle θ_c . **(2marks)**

   (d) Mention four advantages of optic fiber over other transmission medium **(4marks)**

   (e) (i) What is SDH? **(1mark)**
   (ii) What led to SDH development? **(2marks)**

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Section B: Answer any four questions.

2. (a) Describe the two types of intramodal (chromatic) dispersion. **(4 marks)**

(b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(6 marks)**

3. (a) What is different between stimulated Brillonin Scattering (SBS) and stimulated Ramon Scattering (SRS)? **(4 marks)**

(b) Given that the input wavelength is 1449 nm and the Raman shift is 12.2THz, what? is the wavelength of the scattered optical wave? What is the amount of the wavelength shift ? **(6 marks)**

4. (a) Give brief a description of Multimode fiber **(3marks)**

(b) Consider a multimode fiber with a core diameter of 100 μm, core refractive index of 1.475 and a cladding refractive index of 1.455 both at 850 nm. Consider operating this fiber at $\lambda = 850$ nm.

Calculate (i) /estimate the number of modes. **(2marks)**

(ii) The core diameter beyond which the fiber becomes single mode. **(3marks)**

(iii) Calculate the maximum acceptance angle. **(2marks)**

5. Draw a block diagram of optic fiber communication link and describe the function of each block. **(10 marks)**

6. (a) What are the five advantages of SDH over PDH? **(5 marks)**

(b) What are the five main limitations of PDH? **(5 marks)**

7. (a) Compute the material dispersion at 1.55μm if the zero dispersion wavelength is 1.3 μm.The slope coefficient M_0 = -0.095ps/(nm2xKm) **(3marks)**

(b) Compute the frequency spread and wavelength spread between longitudinal modes for a cavity 0.3mm long that is filled with aluminum Gallium Arsenide (AlGaAs).This structure is typical of an AlGaAs laser diode whose mean(center) wavelength is 0.82μ and whose refractive index is 3.6. **(7 marks)**

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(Last paper for B.Eng 07T)

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SEMESTER II EXAMINATION

B.Eng 07T

ET 425 : Fiber Optic communication

TIME: 3 Hours June, 2010

1.Follow all instructions written on your answer booklet

2. This paper consists of sections A and B. Section A has ONE (1) question, section B has FIVE (5) questions. Attempt question one in section A, and any FOUR (4) questions in section B. All questions in section B carry equal marks.
3. You are not allowed to write anything in the question paper
4. Write in black/blue ink and draw diagrams in pencil
5. Write clearly
6. Phones are not allowed in the examination room

1. Answer the following four multiple-choice questions (**2marks)**

(A) What is the index of refraction for a material?

(i) The number of colors it will transmit
(ii) The loss in the material
(iii) The relative speed of light in the material
(iv) The amount of material can be bent

(B) Glass has a higher index of refraction than air. Therefore:

(i) The glass has higher loss than air
(ii) Glass has lower loss than air
(iii) Light travel slower in air than glass
(iv) Light travel faster in air than in glass

(C) . Multimode fiber is a description of...

(i) A cable with multiple fibers
(ii) Multiple fiber in a single tube
(iii) A fiber with multiple paths
(iv) A fiber which transmit multiple wavelength.

(D) What is an acceptance angle?

(i) The angle of light measured within the fiber core

(ii) The smallest angle of incidence at which a light ray passing from one medium to another less refractive medium can be totally reflected from the boundary between the two

(iii)The half-angle of the cone of which incident light is internally reflected by the fiber core

(iv)None of the above

(E) What do the words "open ended capacity" mean as far as optical fiber communication is concerned? **(1mark)**

(F) Label figure 1. from (i) to (vi) **(3 marks)**

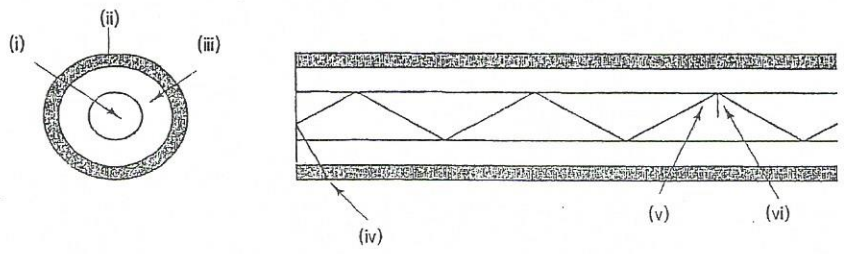

Fig.1 Optic fiber

(G) Define the following terms as related to optic fiber communications

(i) Cladding **(½ mark)**
(ii) Refraction **(½ mark)**
(iii) Total Internal Reflection **(½ mark)**
(iv) Mode field Diameter **(½ mark)**

(H) (i) Define index profile **(½ mark)**
(ii) What are types of index profile? **(1mark)**
(iii) What are the causes, effects and solutions to modal dispersion? **(1 ½ marks)**

(I) (i) What is the spectral width of a light source? **(1mark)**
(ii) What is the difference between Intrinsic and extrinsic loses? **(1 ½ marks)**
(iii) If the light is trying to emerge from glass with n_1=1.5 into air (n_2 =1), what will be the critical angle θ_c . **(1 ½ marks)**

(J)Mention four advantages of optic fiber over other transmission medium **(2 marks)**

(K) (i) What is SDH? **(1mark)**
(ii) What led to SDH development? **(2marks)**

Section B: Answer any four questions.

2. (a) Describe the two types of intramodal (chromatic) dispersion. **(2 marks)**

(b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(6 marks)**

(c) Find the amount of pulse spreading in pure silica for an LED operating at 0.82μm and having a 20nm spectral width. The path is 10km long and the slope coefficient at 0.82μm is 110ps/(nm x km). **(2 marks)**

3. (a) What is different between stimulated Brillonin Scattering (SBS) and stimulated Ramon Scattering (SRS)? **(4 marks)**

(b) Given that the input wavelength is 1449 nm and the Raman shift is 12.2THz, what? is the wavelength of the scattered optical wave? What is the amount of the wavelength shift ? **(4 marks)**

(c) Explain why the sky looks blue during day time and red during sunset/morning **(2marks)**

4. (a) Give brief description of Multimode fiber **(2marks)**

(b) Consider a multimode fiber with a core diameter of 100 μm, core refractive index of 1.475 and a cladding refractive index of 1.455 both at 850 nm. Consider operating this fiber at $\lambda = 850$ nm.

Calculate (i) /estimate the number of modes. **(1marks)**

(ii) The core diameter beyond which the fiber becomes single mode. **(2 marks)**

(iii) Calculate the maximum acceptance angle. **(1 marks)**

(c) Mention four types of optic fiber misalignments. **(4 marks)**

5. (a) Draw a block diagram of optic fiber communication link and describe the function of each block. **(5 marks)**

(b) What are the five advantages of SDH over PDH? **(2 ½ marks)**

(c) What are the five main limitations of PDH? **(2 ½ marks)**

6. (a) Compute the material dispersion at 1.55μm if the zero dispersion wavelength is 1.3 μm.The slope coefficient M_0 = -0.095ps/(nm2xKm) **(3marks)**

(b) Computing the frequency spread and wavelength spread between longitudinal modes for a cavity 0.3mm long that is filled with aluminum Gallium Arsenide (AlGaAs).This structure is typical of an AlGaAs laser diode whose mean(center) wavelength is 0.82μ and whose refractive index is 3.6. **(5 marks)**

(c) Mention types of material used to manufacture optic fiber **(2 marks)**

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SEMESTER II EXAMINATION

B.Eng 08T

ET 425: Fiber Optic communication.

TIME: 3 Hours **July, 2011**

1.Follow all instructions written on your answer booklet

2. This paper consists of sections A and B. Section A has **ONE (1)** question, section B has **SIX (6)** questions. Attempt question one in section A, and any **FOUR (4)** questions in section B. All questions in section B carry equal marks.

3. You are not allowed to write anything in the question paper

4. Write in black/blue ink and draw diagrams in pencil

5. Write clearly

6. Phones are not allowed in the examination room

Section A:

1. (a) Define the following terms as related to optic fiber communications

   (i) Cladding **(1mark)**

   (ii) Refraction **(1mark)**

   (iii) Refractive index **(1mark)**

   (iv) Total Internal Reflection **(1mark)**

   (v) Mode field Diameter **(1mark)**

   (b) (i) Define index profile **(1mark)**

   (ii) What are types of index profile? **(1mark)**

   (iii) What is the cause of and solution to modal dispersion? **(1 ½ marks)**

   (c) (i) What is the spectral width of a light source? **(1mark)**

   (ii) Give the difference between Intrinsic and extrinsic losses? **(1 ½ marks)**

   (iii) If light emerges from glass with n_1=1.5 into air (n_2 =1), what will be the critical angle θ_c.? **(2marks)**

   (d) Mention four advantages of optic fiber over other types transmission medium **(4marks)**

   (e) A 2-km-length multimode fiber has a modal dispersion of 1 ns/km and a chromatic dispersion of 100 ps/km • nm. If it is used with an LED of spectral width of 40 nm,

   (a) What will be the total dispersion? **(2marks).**

   (b) Calculate the bandwidth (BW) of the fiber **(1mark).**

****

Section B: Answer any four questions.

Question 2.

(a) Describe the two types of intramodal (chromatic) dispersion. **(4 marks)**

(b) Starting from Snell's law, derive an expression for the Numerical Aperture (NA) of an optical fiber. **(6 marks)**

Question 3.

(a) Give brief descriptions of Multimode fiber. **(3marks)**

(b) Consider a multimode fiber with a core diameter of $100\mu m$, core refractive index of 1.475 and a cladding refractive index of 1.455 . Consider operating this fiber at $\lambda = 850$ nm .

Calculate (i) The number of modes. **(2marks)**

(ii) The core diameter beyond which the fiber becomes single mode. **(3marks)**

(iii) The maximum acceptance angle. **(2marks)**

Question 4.

Draw a block diagram of optic fiber communication link and describe the function of each block. **(10 marks)**

Question 5.

(a) What are the five advantages of SDH over PDH? **(5 marks)**

(b) State the five main limitations of PDH. **(5 marks)**

Question 6.

(a) What is different between stimulated Brillonin Scattering (SBS) and stimulated Ramon Scattering (SRS)? (4marks)

(b) Compute the material dispersion at 1.55μm if the zero dispersion wavelength is 1.3 μm.C The slope coefficient M_0 = -0.095ps/(nm2xKm) **(3marks)**

(c) Compute the frequency spread and wavelength spread between longitudinal modes for a cavity 0.3mm long that is filled with aluminum Gallium Arsenide (AlGaAs).This structure is typically of an AlGaAs laser diode whose mean(center) wavelength is 0.82μ and whose refractive index is 3.6. **(3 marks)**

Question 7.

When the mean optical power launched into an 8km length of fiber is $120\mu W$, the mean optical power at the fiber is $3\mu W$. Determine

(a) The overall signal attenuation or loss in decibels through the fiber assuming there are no connectors or splices.

(b) The signal attenuation per kilometer for the fibre.

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

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATIONS ENGINEERING

TEST 1
BENG 09 T & CO.
FIBER OPTIC COMMUNICATION

TIME: 45 MINUTES **DATE: MAY 29, 2012**

Student Particulars

NAME	TITI NSABI
ADM. No.	0806 025438
CLASS	BENG 09 TELECOM
SCORE (Under 40)	34

Instructions

1. This paper consists of **FOUR** questions, Attempt all questions.
2. Write the most correct answer in the provided box/blanks on this question paper.
3. Do your rough work on separate sheet given to you as a rough paper.
4. Write in Black/Blue ink and draw diagrams in pencil.
5. Write clearly.
6. Phones are not allowed in the examination room.

QUESTION ONE ***(20 Marks)*** 16/20

Choose the most appropriate answer to the following questions

1. Confining light in a material by surrounding it by another material with lower refractive index is the phenomenon of
   (a) diffraction (b) total internal reflection (c) total internal refraction (d) transmission [B] ✓
2. The main advantage(s) of optical fibers is (are) its ability to _____ than other communications media.
   (a) transport more information (b) transport information faster (c) transport information farther (d) all of the above [D] ✓
3. What does 62.5 refer to when written 62.5/125?
   (a) diameter of the core (b) diameter of the cladding (c) numerical aperture (d) index profile [A] ✓
4. In graded-index optical fiber, the index profile approximates a parabola. The benefit of this is
   (a) reduced bandwidth (b) reduced cross-talk (c) increased modal dispersion
   (d) reduced modal dispersion. [D] ✓
5. Loose-tube cable is used where
   (a) ease of termination is a concern (b) high pulling strength is required
   (c) high flexibility is a concern (d) several fibers must fit in a small space. [B] ✓
6. A composite cable contains
   (a) tight-buffered cables (b) singlemode and multimode fibers
   (c) loose-tube and tight-buffered fibers (d) copper conductors and optical fibers [D] ✓

BEST WISHES

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATIONS ENGINEERING

7. When pulling fiber it is best to pull on the _____ of the cable.

   (a) fiber (b) buffer tubes (c) jacket (d) strength member

8. The minimum bending radius of an optical fiber cable should be no less than _____ times the cable diameter when being pulled into place.

   (a) 10 (b) 15 (c) 20 (d) 25

9. A nonconductive optical fiber cable for use in an air-handling plenum would be labeled

   (a) OFNP (b) OFCP (c) OFNR (d) OFCR.

10. Fiber optic joints should have

    (a) back reflection (b) an index matching gel (c) high mechanical strength and low loss (d)attenuation.

QUESTION TWO *(3 Marks)*

Match the following fibers to the application they are best suited for:

(i) Graded-index multimode	B	(a) long-distance telecommunications
(ii) Step-index multimode	C	(b) data communications .
(iii) Single mode	A	(c) efficient source power coupling

QUESTION THREE *(6 Marks)*

Match the type of cable listed with description in the right column.

(i) Zipcord cable	B	(a) contains single and multimode fibers
(ii) Tightpack cable	F	(b) two fibers, tight-buffered, mostly used for patch cords
(iii)Breakout cable	D	(c) contains copper conductors and optical fiber
(iv)Loose-tube cable	E	(d) distribution cables
(v) Composite cable	C	(e) a small diameter, high-fiber count cable
(vi)Hybrid cable	A	(f). several simplex units cabled together

QUESTION FOUR *(11 Marks)*

Consider a multimode step-index fiber with a glass core ($n_1 = 1.5$) and a fused quartz cladding ($n_2 = 1.46$). The source-to-fiber media is air. From the given data

a) the critical angle (Q_c) = 76.74° — $\sin^{-1}(n_2/n_1)$

b) the acceptance angle (Q_{in}) = 20.13° — $\sin^{-1} NA = \sin^{-1}(\sqrt{n_1^2 - n_2^2})$

c) the numerical aperture = 0.344 — $\sqrt{n_1^2 - n_2^2}$

BEST WISHES

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SEMESTER II EXAMINATION

BENG 09T

ETU 08210 : Fiber Optic communication

TIME: 3 Hours **July, 2012**

Instructions

1. Follow all instructions written on your answer booklet.
2. This paper consists of sections **A** and **B**. Attempt question **ONE** in section **A**, and any **THREE** questions in section **B**.
3. You are not allowed to write anything in the question paper
4. Write in black/blue ink and draw diagrams in pencil
5. Write clearly
6. Phones are not allowed in the examination room

This paper consists of four printed pages

SECTION A

QUESTION ONE

a) Discus at least four advantages of optic fiber cables versus metallic cables. ***(8 Marks)***

b) Define index profile. Mention two types of index profile you know. ***(6 Marks)***

c) Explain four major reasons for fiber joints. ***(8 Marks)***

d) There are two major types of dispersion in optical fibers, discus them. ***(4 Marks)***

e) Choose the most appropriate answer to the following questions ***(5 Marks)***

i. What does 125 refer to when written 62.5/125?

(a) diameter of the core (b) diameter of the cladding (c) numerical aperture (d) no answer

ii. Loose-tube cable is used where

(a) ease of termination is a concern (b) high pulling strength is required (c) high flexibility is a concern (d) several fibers must fit in a small space.

iii. When pulling fiber it is best to pull on the _____ of the cable.

(a) fiber (b) buffer tubes (c) jacket (d) strength member

iv. The minimum bending radius of an optical fiber cable should be no less than _____ times the cable diameter when being pulled into place.

(a) 10 (b) 15 (c) 20 (d) 25

v. A conductive optical fiber cable for use in an air-handling plenum would be labeled

(a) OFNP (b) OFCP (c) OFNR (d) OFCR.

(f) Match the following fibers to the application they are best suited for: ***(3 Marks)***

(i) Graded-index multimode	(a) long-distance telecommunications
(ii) Step-index multimode	(b) data communications
(iii) Single mode	(c) efficient source power coupling

(g) Match the type of cable listed with description in the right column. ***(6 Marks)***

(i) Zipcord cable	(a) contains single and multimode fibers
(ii) Tightpack cable	(b) two fibers, tight-buffered, mostly used for patch cords
(iii) Breakout cable	(c) contains copper conductors and optical fiber
(iv) Loose-tube cable	(d) distribution cables
(v) Composite cable	(e) a small diameter, high-fiber count cable
(vi) Hybrid cable	(f) several simplex units cabled together

SECTION B

QUESTION TWO

a) What is the difference between Intrinsic and Extrinsic losses? Give two examples for each. *(6 Marks)*

b) Draw a block diagram of optic fiber communication link and describe the function of each block. *(8 Marks)*

c) Explain what is meant by a graded index optical fiber. Indicate the major advantage of this type of fiber with regard to multimode propagation. *(6 Marks)*

QUESTION THREE *(20 Marks)*

a) For the light entering the fiber from free space, show how the Numerical Aperture (NA) of optical fiber is related to both core and cladding refractive indexes.*(8 Marks)*

b) A multimode step index fiber has a glass core with a refractive index (n_1) = 1.5 and a fused quartz cladding with a refractive index (n_2) = 1.46. If the source-to-fiber media is air, calculate: *(6 Marks)*

i. the critical angle (Q_c);

ii. the acceptance angle (Q_{in});

iii. the numerical aperture (NA).

c) Briefly describe at least three installation specifications of optic fiber cable.*(6 Marks)*

QUESTION FOUR

a) Define the following as far as optical fiber system link budget is concern; *(8 Marks)*

i. Link power budget
ii. Link loss budget
iii. Receiver sensitivity
iv. Link loss margin

b) Determine the optical power received in dBm and watts for a 20-km optical fiber link with the following parameters: *(12 Marks)*

LED output power of 30 mW
Four, 5-km sections of optical cable each with a loss of 0.5 dB/km
Three cable-to-cable connectors with a loss of 2dB each
No cable splices
Light source-to-fiber interface loss of 1.9 dB
Fiber-to-light detectors loss of 2.1 dB
No losses due to cable bends

QUESTION FIVE *(20 Marks)*

a) Describe with the aid of simple ray diagrams: *(6 Marks)*

i. the multimode step index fiber;
ii. the single mode step index fiber.

b) Discuss at least two advantages and two disadvantages of SM and MM types of fiber for use as an optical channel. *(8 Marks)*

c) A 3 μm diameter single mode optical fiber has a core and cladding indexes of refraction of 1.545 and 1.510 respectively. Determine the cut off wavelength for the fiber to transmit single mode. *(6 Marks)*

NKJ

DAR ES SALAAM INSTITUTE OF TECHNOLOGY

GENERAL STUDIES DEPARTMENT

FIRST TEST- GSU 08201: ENTREPRENEURSHIP FOR ENGINEERS

CLASS: B.ENG. ELECTRICAL 1 & COMPUTER **DATE: 2nd April, 2014.**

Instructions: Answer Four (4) questions only. Each question carries 10 marks

1. Explain any five (5) different entrepreneurship characteristics that are displayed by successful entrepreneurs.
2. List any ten methods which can be employed to develop entrepreneurial attributes/characteristics.
3. What are the five (5) reasons/ which may lead a person decide to establish a business venture?
4. What is meant by the following types of Business Ownership:
   (a) Sole Proprietorship; (b) Partnership. Give two advantages and one disadvantage of each.
5. (a) Define the terms (i) microenterprise (ii) small enterprise.(b) List any six characteristics of a small business.
6. Give any five reasons why many educated people in this country opt for wage-employment despite the importance of self –employment.
7. (a) What is business growth? Explain the factors that influence the capacity of small business to grow.