Pursuing Excellence

Busitema University

Faculty of Engineering

Department of Computer Engineering

UNIVERSITY EXAMINATIONS

Semester TWO 2019/2020

Course Code:	**BCT4204**
Course Name:	**Optical Fibre Communications**
Program of Study:	**B. Computer Engineering**
Year of Study:	**IV**
Date of Examinations:	**3/12/2020**
Time of Examinations:	**8:00am – 11:00am**

INSTRUCTIONS: Paper consists of Six (6) questions.

- **All questions carry equal Marks**
- **Attempt any five (5) questions**
- **Do not write anything on the question paper**
- **Time allowed: 3hrs**

Please turn over for the questions

Scanned with CamScanner

2020

Question 1

a) Explain with the aid of a diagram what is meant by the terms acceptance angle and numerical aperture for an optical fiber cable. [4 Marks]

b) Show that the Numeral aperture (NA) of a single mode step index fiber can be expressed as

$NA = n_1\sqrt{2\Delta}$,Where Δ=the core-cladding index difference. [6Marks]

c) Given the mean optical power launched into an 8km length of fiber is 120μW, the mean optical power at the output as 3 μW. Determine:

(i) The overall signal attenuation (or loss) in decibels through the fiber assuming there are no connection losses or splices. [2Marks]

(ii) The signal attenuation per kilometer for the fiber. [2Marks]

(iii) The overall signal attenuation for a 10km optical link using the same fiber with splices at 1km intervals, each giving an attenuation of 1 decibel. [3Marks]

(iv) The input /output ratio in (iii) above. [3Marks]

Question 2

a) Briefly explain the requirements for an optical source used in optical communication systems. [5 Marks]

b) Explain two (2) technical requirements of a good photo detector, why is the photodiode preferred in fiber optic communication system? [5 Marks]

c) In the context of optical fiber communications, briefly explain the following terms

(i) Double Heterojunction. [3 Marks]

(ii) Rise time and fall time. [3 Marks]

(iii) Shot noise. [2 Marks]

(iv) Dark current. [2 Marks]

Question 3

a) Attenuation in optical fibers mainly caused by absorption and scattering. Explain in brief what you understand by absorption and scattering? [11 Marks]

b) If the core layer of an optical fiber is made from silica with refractive index 1.45 and if the refractive index of the cladding layer is 1% less than of the core, calculate;

(i) cladding layer refractive index, [3 Marks]

(ii) Critical angle [3 Marks]

(iii) Numerical aperture. [3 Marks]

Scanned with CamScanner

Question 4

a) Outline four common reasons why power margins are employed in the design of optical transmission systems. [4 Marks]

b) A technology Innovation Company is setting up an office in eastern region within 100km radius from Busitema University main campus. The company desires to be connected with an optical fiber link with the following specifications as in the table below.

Parameter	Value
Data rate	1 GHz
DFB Laser spectral width	0.1nm
SM fiber dispersion at 1550nm	-0.02 ns/km/nm
Rise time of the receiver	0.1 nsec
Rise time of the transmitter	0.1nsec
Fiber loss	0.4dB/km
Transmitter power	-3 dBm
Minimum Detectable optical power	-40 dBm

Neglecting splice and connector losses, state the maximum optical link length you can achieve with the above specifications and commend on the feasibility of this optical link. 16 Marks]

Question 5

a) Describe the three main physical processes that can occur between electrons, holes and photons in optical fiber communication, in each case indicating whether the process is dominant in a laser, Photodiode or light emitting diode. [9 Marks]

b) Explain the difference between indirect –and direct-gap semiconductors. What is the consequence of being an indirect-gap material? [5 Marks]

c) Explain the difference between semiconductor homojunctions, and sketch their energy band diagrams in equilibrium. What is the main advantage of the heterojunction in optical fiber communication? [6 Marks]

Question 6

In fiber optic transmission lines, Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) are widely used for high speed point to-point transmission links.

a) Briefly outline the difference between SONET and SDH. [4 Marks]

b) Explain the basic SDH & SONET transmission formats with the aid of a diagram. [4Marks]

c) For an SDH and SONET frame of a 125-μs duration, calculate the following

(i) The basic transmission bit rate [4Marks]

(ii) Synchronous payload envelope(SPE) rate [4Marks]

(iii)The user data rate [4Marks]

End of Paper, Good Luck.

Scanned with CamScanner