



**School of Computing Skills  
Session: 2021-22 (Summer Semester)  
B. Voc. Program, 3<sup>rd</sup> Semester,  
End-Sem. Examination**

**Course Code: ITN1302**

**Time: 2 Hour**

**Course Name: Wireless Networks**

**Max. Marks: 50**

**Section – A**

10X01 = 10 Marks

Q1. GSM is a secure \_\_\_\_\_ system.

- a. Wired
- b. Wireless
- c. Simple
- d. Complex

Q2. SIM in the GSM network stands for \_\_\_\_\_.

- a. Subscriber Identity Module
- b. Subscriber Investigation Mobile
- c. Subscriber Identification Mobile
- d. Smart Identification Module

Q3. \_\_\_\_\_ used by the service providers of telecommunications to manage networks.

- a. Base Station Subsystem
- b. Network Switching Subsystem
- c. GPRS Core Network
- d. Operations Support System (OSS)

Q4. GSM offers services like \_\_\_\_\_.

- a. voice
- b. Data
- c. Roaming
- d. All the above

Q5 The permanent data of the subscriber is stored in \_\_\_\_\_.

- a. Home Location Register (HLR)
- b. Visitor Location Register (VLR)
- c. Authentication Center (AUC)
- d. Equipment Identity Register (EIR)

Q6. In wireless ad-hoc network \_\_\_\_\_

- a. access point is not required
- b. access point is must
- c. nodes are not required
- d. all nodes are access points



- Q7. In wireless distribution system \_\_\_\_\_
- a. multiple access point are inter-connected with each other
  - b. there is no access point
  - c. only one access point exists
  - d. access points are not required
- Q8. In wireless network an extended service set is a set of \_\_\_\_\_
- a. connected basic service sets
  - b. all stations
  - c. all access points
  - d. connected access points
- Q9. The frequency band of Bluetooth radio is around \_\_\_\_\_
- a. 2.1 GHz
  - b. 2.3 GHz
  - c. 2.4 GHz
  - d. None of the above
- Q10. The single piconet formed by \_\_\_\_\_
- a. One slave and one master
  - b. One slave and multiple masters
  - c. Multiple slaves and one master
  - d. Multiple slaves and multiple masters

**Section – B**

04X04 = 16 Marks

- Q1. What is a wireless LAN?
- Q2. What is an access point?
- Q3. What are IBSS and BSS in WLAN?
- Q4. Do I Need a License to Operate WLANs?

**Section – C**

04X06 = 24 Marks

- Q1. Calculate the link margin for link with following parameters. 20 dBm( Tx Power), + 10 dBi (Tx Antenna Gain), - 2 dB (Tx Cable Losses), -114 dB (free space loss @5 km), + 14 dBi (Rx Antenna Gain), - 2 dB (Rx Cable Losses, -74 dBm (expected received signal level) , -(-82 dBm) (sensitivity of Rx).
- Q2. Explain the difference between TDMA, FDMA and CDMA? Which of these are used in GSM networks?
- Q3. What is the difference between WiFi and Bluetooth?
- Q4. What is the difference between ad-hoc and infrastructure mode in IEEE 802.11?

Set – A

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## Section – A

**Answers**

- Q1. B
- Q2. A
- Q3. D
- Q4. D
- Q5. A
- Q6. A
- Q7. A
- Q8. A
- Q9. C
- Q10. A

## Section – B

Ans1. A WLAN is a type of Local Area Network (LAN) that uses high frequency radio waves rather than wires to communicate and transmit data. It is a flexible data communication system implemented as an extension to or as an alternative for, a wired LAN.

Ans2. An access point connects wired and wireless networks together and enables the sending and receiving of data between wireless clients and the wired network. Using multiple access points increases total system capacity and range. Users can "roam" between access points without losing their connection similar to the way a cellular phone can roam between cellular phone towers.

Ans3. Independent Basic Service Set (IBSS) allows two or more devices to communicate directly with each other without a need for a central device. Basic Service Set (BSS) wireless LAN is established using a central device called an Access Point that centralizes access and control over a group of wireless devices.

Ans4. WLAN equipment operates in a 2.4 GHz and 5 GHz frequency spectrum which are license free in India. We do not need any license to operate a WLAN in these two frequency bands.

### Section – C

Ans1. 8 db.

Ans2. TDMA, FDMA and CDMA are access techniques to utilize time, frequency and code respectively. TDMA means Time Division Multiple Access, FDMA means Frequency Division Multiple Access and CDMA means Code Division Multiple Access. GSM uses both TDMA and FDMA. FDMA and TDMA are used in GSM Networks.

Ans3. WiFi fall under WLAN category while Bluetooth fall under WPAN category. WLAN specifications are published under IEEE 802.11 and Bluetooth under IEEE 802.15 standards. Bluetooth is the standard for wireless personal area networks or WPAN. It allows high speed transmission of data over very short distances. WiFi covers more distance than Bluetooth.

Ans4. In ad-hoc mode WLAN mobile and stationary terminals referred as STAs (stations) communicate directly. In the infrastructure mode STAs communicate via entity called as AP (Access Point). It is similar to mesh and star topologies used in other wireless networks. Infrastructure mode used to connect with wired network.



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  - None of the above
- Q10. GSM is a secure \_\_\_\_\_ system.
- Wired
  - Wireless
  - Simple
  - Complex

## Section – B

04X04 = 16 Marks

- Q1. Do I Need a License to Operate WLANs?
- Q2. What is an access point?
- Q3. What are IBSS and BSS in WLAN?
- Q4. What is a wireless LAN?

## Section – C

04X06 = 24 Marks

- Q1. Explain the difference between TDMA, FDMA and CDMA? Which of these are used in GSM networks?
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- Q3. What is the difference between ad-hoc and infrastructure mode in IEEE 802.11?
- Q4. Calculate the link margin for link with following parameters. 20 dBm (Tx Power), + 10 dBi (Tx Antenna Gain), - 2 dB (Tx Cable Losses), -114 dB (free space loss @5 km), + 14 dBi (Rx Antenna Gain), - 2 dB (Rx Cable Losses, -74 dBm (expected received signal level) , -(-82 dBm) (sensitivity of Rx).

Set – B

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**Section – A**

**Answers**

Q1. A

Q2. A

Q3. D

Q4. D

Q5. A

Q6. A

Q7. A

Q8. A

Q9. C

Q10. B

**Section – B**

Ans1. WLAN equipment operates in a 2.4 GHz and 5 GHz frequency spectrum which are license free in India. We do not need any license to operate a WLAN in these two frequency bands.

Ans2. An access point connects wired and wireless networks together and enables the sending and receiving of data between wireless clients and the wired network. Using multiple access points increases total system capacity and range. Users can "roam" between access points without losing their connection similar to the way a cellular phone can roam between cellular phone towers.

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Ans4. A WLAN is a type of Local Area Network (LAN) that uses high frequency radio waves rather than wires to communicate and transmit data. It is a flexible data communication system implemented as an extension to or as an alternative for, a wired LAN.

### Section – C

Ans1. TDMA, FDMA and CDMA are access techniques to utilize time, frequency and code respectively. TDMA means Time Division Multiple Access, FDMA means Frequency Division Multiple Access and CDMA means Code Division Multiple Access. GSM uses both TDMA and FDMA. FDMA and TDMA are used in GSM Networks.

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Ans4. 8 db.



**School of Computing Skills**

**Session: 2021-2022(Summer Semester)**

**B.Voc Program, III Semester**

**End-Sem. Examination**

**Course Code : ITN1303**

**Course Name : Basic of Network Security**

**Time: 2 hour**

**Instruction: Explain in detail for long answer**

**Max. Marks : 50**

**Section-A**

**1X10 = 10 Marks**

**Q.1 Which of the following is true about Wireshark?**

- a) It is a network connection security tool.
- b) It is a connection analysis tool.
- c) It is a defending malicious packet filtering tool.
- d) It is a network protocol analysis tool.

**Q.2 The Domain Name System is maintained by which of the following:**

- a) A single server
- b) A single computer
- c) A distributed database system.
- d) None of the above

**Q.3 What is an antivirus?**

- a) A bigger and more dangerous virus
- b) Software used to duplicate viruses
- c) Computer software used to prevent, detect and remove malicious software
- d) A biological agent that reproduces itself inside the cells of living things

**Q.4 What is port no of DNS .**

- a) 51
- b) 53
- c) 55
- d) 58

**Q.5 What is full form of DNS**

- A. Domain name service
- B. Domain name server
- C. Data name service
- D. Data name server

**Q.6 Which malicious program cannot do anything until actions are taken to activate the file attached by the malware.**

- A. Trojan Horse
- B. Worm



D. Bots

**Q.7 Which of the following malware do not replicate or reproduce through infection?**

- A. Worms
- B. Trojans
- C. Viruses
- D. Rootkits

**Q.8 Network Security provides authentication and access control for resources.**

- a) True
- b) False

**Q.9 An algorithm in encryption is called \_\_\_\_\_**

- a) Algorithm
- b) Procedure
- c) Cipher
- d) Module

**Q.10 Which is not an objective of network security?**

- a) Identification
- b) Authentication
- c) Access control
- d) Lock

**Section B**

**04X04= 16 Marks**

**Q.1 Differentiate between threat, vulnerability and risk.**

**Q.2 Who are Black Hat, White Hat and Grey Hat Hackers?**

**Q.3. What are the types of Cyber Security?**

**Q.4. What do you mean by Phishing?**

**Section C**

**04X06=24 Marks**

**Q.1 What do you mean by a DDoS attack? How can you prevent it?**

**Q.2 What are the benefits of Cyber Security?**

**Q.3 What are the differences among encoding, encryption and hashing?**

**Q.4 What are the factors that affect the performance of the network?**

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Max. Marks : 50

Set A:

**Section A : answer sheet**

**Q.1 C**

**Q.2 C**

**Q.3 C**

**Q.4 B**

**Q.5 A**

**Q.6 C**

**Q.7 C**

**Q.8 A**

**Q.9 C**

**Q.10 D**

**Section B**

**Answer1 : Threat:** A threat is any form of hazard that has the potential to destroy or steal data, disrupt operations, or cause harm in general. Malware, phishing, data breaches, and even unethical employees are all examples of threats. Threat actors, who might be individuals or groups with a variety of backgrounds and motives, express threats. Understanding threats is essential for developing effective mitigations and making informed cybersecurity decisions. Threat intelligence is information regarding threats and threat actors.

**Vulnerability:** A vulnerability is a flaw in hardware, software, personnel, or procedures that threat actors can use to achieve their objectives.

Physical vulnerabilities, such as publicly exposed networking equipment, software vulnerabilities, such as a buffer overflow vulnerability in a browser, and even human vulnerabilities, such as an employee vulnerable to phishing assaults, are all examples of vulnerabilities.

Vulnerability management is the process of identifying, reporting and repairing vulnerabilities. A zero-day vulnerability is a vulnerability for which a remedy is not yet available.

**Risk:** The probability of a threat and the consequence of a vulnerability are combined to form risk. To put it another way, the risk is the likelihood of a threat agent successfully exploiting a vulnerability, which may be calculated using the formula:

**Risk = Likelihood of a threat \* Vulnerability Impact**

Risk management is the process of identifying all potential hazards, analyzing their impact, and determining the best course of action. It's a never-ending procedure that examines new threats and vulnerabilities on a regular basis. Risks can be avoided, minimized, accepted, or passed to a third party depending on the response chosen.

**Answer 2 : Black Hat hackers**, sometimes known as crackers, attempt to obtain unauthorized access to a system in order to disrupt its operations or steal critical data.

Because of its malicious aim, black hat hacking is always illegal, including stealing company data, violating the privacy, causing system damage, and blocking network connection, among other things.

Ethical hackers are also referred to as **White hat hackers**. As part of penetration testing and vulnerability assessments, they never intend to harm a system; rather, they strive to uncover holes in a computer or network system. Ethical hacking is not a crime and is one of the most difficult professions in the IT business. Many businesses hire ethical hackers to do penetration tests and vulnerability assessments.

**Grey hat hackers** combine elements of both black and white hat hacking. They act without malice, but for the sake of amusement, they exploit a security flaw in a computer system or network without the permission or knowledge of the owner. Their goal is to draw the owners' attention to the flaw in the hope of receiving gratitude or a small reward.

**Answer 3 : Network security:** It is the process of securing a computer network against unauthorized access, intruders, attacks, disruption, and misuse using hardware and software. This security aids in the protection of an organization's assets from both external and internal threats. Example: Using a Firewall.

**Application security:** It entails safeguarding software and devices against malicious attacks. This can be accomplished by regularly updating the apps to ensure that they are secure against threats.

**Data security:** It entails putting in place a strong data storage system that ensures data integrity and privacy while in storage and transport.

**Answer 4 : Phishing** is a sort of cybercrime in which the sender appears to be a legitimate entity such as PayPal, eBay, financial institutions, or friends and coworkers. They send an email, phone call, or text message to a target or target with a link to convince them to click on the link. This link will take users to a fake website where they will be asked to enter sensitive information such as personal information, banking and credit card information, social security numbers, usernames, and passwords. By clicking the link, malware will be installed on the target machines, allowing hackers to remotely control them.

### Section C

**Answer 1 :** It's a form of cyber threat or malicious effort in which fraudsters use Internet traffic to fulfill legitimate requests to the target or its surrounding infrastructure, causing the target's regular traffic to be disrupted. The requests originate from a variety of IP addresses, which might cause the system to become unworkable, overload its servers, cause them to slow down or go offline, or prevent an organization from performing its essential responsibilities.

The methods listed below will assist you in stopping and preventing DDOS attacks:

- \* Create a denial of the service response strategy.
- Maintain the integrity of your network infrastructure.
- Use fundamental network security measures.
- Keep a solid network architecture.
- Recognize the Warning Signs
- \* Think about DDoS as a service.

**Answer 2 :** The following are some of the advantages of putting cybersecurity in place and keeping it up to date:

- Businesses are protected from cyberattacks and data breaches.
- Both data and network security are safeguarded.
- Unauthorized user access is kept to a minimum.
- There is a quicker recovery time after a breach.
- Protection for end-users and endpoint devices.
- Regulatory compliance.
- Operational consistency.
- Developers, partners, consumers, stakeholders, and employees have a higher level of trust in the company's reputation.

Answer 3 : What are the differences among encoding, encryption and hashing?

Encoding: Basically encoding is used to protect the integrity of data as it crosses through communication network to keep its original message upon arriving. It is primarily an insecure function because it is easily reversible.

Encryption: Encryption is basically designed for confidentiality and data integrity and reversible only if you have the appropriate key

Hashing: With hashing the operation is one-way i.e. non-reversible. It takes an input (or ,message ) and returns a fixed-size string, which is called the hash value.

- Answer 4: Type of transmission media
- Software
- Number of users
- Hardware





**School of Computing Skills**

**Session: 2021-2022(Summer Semester)**

**B.Voc Program, III Semester**

**End-Sem. Examination**

**Course Code : ITN1303**

**Course Name : Basic of Network Security**

**Time: 2 hour**

**Instruction: Explain in detail for long answer**

**Max. Marks : 50**

**Section-A**

**1X10 = 10 Marks**

**Q.1 Malware is short form of ?**

- A. malicious hardware
- B. malicious software
- C. Both A and B
- D. None of the above

**Q.2 Transport layer protocol is ?**

- a) HTTP
- b) TCP
- c) HTTPS
- d) ICMP

**Q.3 What is an antivirus?**

- a) A bigger and more dangerous virus
- b) Software used to duplicate viruses
- c) Computer software used to prevent, detect and remove malicious software
- d) A biological agent that reproduces itself inside the cells of living things

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**Q.7 Which of the following malware do not replicate or reproduce through infection?**

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**Q.8 Network Security provides authentication and access control for resources.**

- a) True
- b) False

**Q.9 An algorithm in encryption is called \_\_\_\_\_**

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- d) Module

**Q.10 Which is not an objective of network security?**

- a) Identification
- b) Authentication
- c) Access control
- d) Lock

**Section B**

**04X04= 16 Marks**

**Q.1 Explain the basic working of network security.**

**Q.2 What do you mean by the CIA Triad?**

**Q.3. What is the difference between Network Security and Cyber Security?**

**Q.4. What is Malware?**

**Section C**

**04X06=24 Marks**

**Q.1 What are the major roles and responsibilities of a network engineer?**

**Q.2 What are the potential consequences of a network security attack for an organization?**

**Q.3 What are the factors that affect the performance of the network?**

**Q.4 What are the different types of network security tools?**



**School of Computing Skills  
Session: 2020-21 (Summer Semester)  
B. Voc. Program, III Semester,  
End-Sem. Examination**

**Course Code: ITN 1305  
Course Name: Optical Fiber Communication**

**Time: 2 Hour  
Max. Marks: 50**

**Section – A**

10X01 = 10 Marks

**Q1. Which fiber is preferred for long distance communication?**

- (A) Step index single mode fiber (B) Graded index multimode fiber  
(C) Graded index fiber (D) step index multimode fiber

**Q2. Main advantage of fiber optic cable over co-axial cable is.....**

- (A) Easy handling (B) Less weight  
(C) Easy Testing (D) Low loss

**Q3. What is the standard form of OTDR?**

- (A) Orthogonal time domain reflectometer (B) Orthogonal time dispersion reflectometer  
(C) Optical time domain reflectometer (D) None of the above

**Q4. Which one of the following is a multi-fiber contact connector?**

- (A) ST (B) SC  
(C) MT - RJ (D) BICONIC

**Q5. How many types of techniques are there in fiber splicing?**

- (A) One (B) Two  
(C) Three (D) Four

**Q6. What is the main advantage of fusion splicing?**

- (A) Gives high quality of joint (B) Size of the splice are small  
(C) Attenuation is low (D) All of the above

**Q7. What are the disadvantages of fusion splicing?**

- (A) Fiber will get weak (B) Tensile strength of fiber decreases  
(C) Tensile strength of fiber increases (D) Both a and b

**Q8. What are the losses generated when we do fiber-to-fiber joints?**

- (A) Core and misalignment (B) Gap and angular losses  
(C) Losses due to difference in diameter (D) All of the above

**Q9. What is the standard form of LASER?**

- (A) Low Amplifier by Simple mission of Radiation (B) Light Amplification by Simulated emission of Radiation  
(C) Light Amplifier by Simple mission of Radiation (D) None of the above

**Q10. In a multi-mode of optical fiber \_\_\_\_\_**

- (A) Bandwidth is low (50mHz) (B) Used for short-distance communication  
(C) V number is greater than 2.405 (D) All of the above



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## Section – B

04X04 = 16 Marks

- Q1. What are the disadvantages of OFC system?**
- Q2. What are the properties of a good connector?**
- Q3. What are the application of optical fiber communication system?**
- Q4. What is core and cladding in optical fibers explain with diagram.**

## Section – C

04X06 = 24 Marks

- Q1. Write a short note on (any four)**
- A. Connectors.**
  - B. Optical splicer**
  - C. LIU**
  - D. Power meter**
  - E. OTDR**
- Q2. Write a note on fusion splicing method.**
- Q3. What is the difference between single mode fiber and multimode fiber?**
- Q4. What are the 7 different types of cable connectors?**

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**Course Code : ITN1303**

**Course Name : Basic of Network Security**

**Time: 2 hour**

**Instruction: Explain in detail for long answer**

**Max. Marks : 50**

Set A:

**Section A : answer sheet**

Q.1 B

Q.2 B

Q.3 C

Q.4 C

Q.5 A

Q.6 C

Q.7 C

Q.8 A

Q.9 C

Q.10 D

**Section B : answer sheet**

**Answer 1 :** Network security is an activity that is designed to protect the usability and integrity of the network and data. It includes both hardware and software technologies and targets a variety of threats. It combines various layers of defences at the edge and in the network. Every network security layer implements distinct policies and controls. While authorized users gain access to network resources, the malicious or unauthorized agents are blocked from carrying out exploits and threats.

**Answer 2:** IA stands for Confidentiality, Integrity, and Availability. CIA or CIA Triad is a popular model that is designed to maintain privacy policies for information security in organizations. Security professionals evaluate threats after assessing their potential impact on the confidentiality, integrity, and availability of the organization's assets. A network is secure only when it possesses the components that constitute the CIA Triad.

- Confidentiality refers to an organization's efforts to keep its data private or secret. Thus, only those who are authorized have access to specific assets while those who are unauthorized are prevented from accessing.
- Integrity refers to ensuring that data is authentic and reliable. Also, it has not been tampered with.
- Availability refers to ensuring that systems, applications, and data are up and running; and authorized users have access to resources when they are needed.

**Answer 3 :** Cyber security protects internet-connected systems, such as hardware, software, programs, and data from potential cyberattacks. Network Security is a subset of Cyber Security and protects the data flowing over the network against unauthorized access. It protects the confidentiality, integrity, usability, and availability of computer networks and data.

Answer 4 : Short for malicious software, Malware refers to software variants, such as viruses, worms, adware ransomware, and spyware that are designed to damage and destroy data and systems or to gain unauthorized access to a network. Malware is usually sent in the form of a link or file over email. It requires the target to click on the link or open the file to execute the malware.

### Section C

Answer 1. Major roles and responsibilities of a network engineer include –

1. Designing and implementing new network solutions
2. Installing and configuring network equipment
3. Improving the efficiency of current networks
4. Procuring network equipment and managing subcontractors involved with network installation
5. Maximizing network efficiency
6. Monitoring network performance and troubleshooting
7. Identifying faults in the network
8. Upgrading network equipment
9. Reporting network status to key stakeholders

Answer 2 : A network security attack can result in irreversible damage to the organization. Some of the potential outcomes of a network security attack are:

- Loss of sensitive information and proprietary data
- Reduction profits
- Loss of value with shareholders
- Loss of reputation
- Deterioration of brand value
- Reduced trust with customers

Answer 3 : The factors that affect the performance of the network are:

- Type of transmission media
- Software
- Number of users
- Hardware

Answer 4 : The different types of network security tools are:

- Access control
- Antivirus and antimalware software
- Application security
- Data Loss Prevention (DLP)
- Email security
- Firewalls
- Intrusion prevention systems
- Mobile device security
- Host-based Intrusion Detection System (HIDS)
- Network Intrusion Detection System (NIDS)
- Behavioral analytics
- Network segmentation
- Virtual Private Network (VPN)
- Web security
- Wireless security



# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

Set – A

School of Computing Skills  
Session: 2020-21 (Summer Semester)  
B. Voc. Program, III Semester,  
End-Sem. Examination

Course Code: ITN 1305  
Course Name: Optical Fiber Communication

Time: 2 Hour  
Max. Marks: 50

Instruction: (if any)

## Section – A

10X01 = 10 Marks

**Q1. Which fiber is preferred for long distance communication?**

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(C) Graded index fiber (D) step index multimode fiber

ANS: (A)

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ANS: (D)

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- (A) Orthogonal time domain reflectometer (B) Orthogonal time dispersion reflectometer  
(C) Optical time domain reflectometer (D) None of the above

ANS: (C)

**Q4. Which one of the following is a multi-fiber contact connector?**

- (A) ST (B) SC  
(C) MT - RJ (D) BICONIC

ANS: (C)

**Q5. How many types of techniques are there in fiber splicing?**

- (A) One (B) Two  
(C) Three (D) Four

ANS: (B)

**Q6. What is the main advantage of fusion splicing?**

- (A) Gives high quality of joint (B) Size of the splice are small  
(C) Attenuation is low (D) All of the above

ANS: (D)

**Q7. What are the disadvantages of fusion splicing?**

- (A) Fiber will get weak (B) Tensile strength of fiber decreases  
(C) Tensile strength of fiber increases (D) Both a and b

ANS: (D)

**Q8. What are the losses generated when we do fiber-to-fiber joints?**

- (A) Core and misalignment (B) Gap and angular losses  
(C) Losses due to difference in diameter (D) All of the above

ANS: (D)

**Q9. What is the standard form of LASER?**

- (A) Low Amplifier by Simple mission of Radiation (B) Light Amplification by Simulated emission of Radiation  
(C) Light Amplifier by Simple mission of Radiation (D) None of the above

ANS: (B)

**Q10. In a multi-mode of optical fiber \_\_\_\_\_**

- (A) Bandwidth is low (50mHz) (B) Used for short-distance communication  
(C) V number is greater than 2.405 (D) All of the above

ANS: (D)



# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

## Section – B

04X04 = 16 Marks

**Q1. What are the disadvantages of OFC system?**

**ANS:** Difficult to Splice: -The optical fibers are difficult to splice, and there is loss of the light in the fiber due to scattering. They have limited physical arc of cables. If you bend them too much, they will break.

Expensive to Install: -The optical fibers are more expensive to install, and they have to be installed by the specialists. They are not as robust as the wires. Special test equipment is often required to the optical fiber.

Highly Susceptible: -The fiber optic cable is a small and compact cable, and it is highly susceptible to becoming cut or damaged during installation or construction activities. The fiber optic cables can provide tremendous data transmission capabilities. So, when the fiber optic cabling is chosen as the transmission medium, it is necessary to address restoration, backup and survivability.

Can't Be Curved: -The transmission on the optical fiber requires repeating at distance intervals. The fibers can be broken or have transmission losses when wrapped around curves of only a few centimeters radius.

**Q2. What are the properties of a good connector?**

**ANS:** - Some of the basic features for a good connector are **reliability and low cost, high return and low insertion losses, easy to operate and install and low sensitivity for environmental conditions**. These connectors also help in quicker disconnection and connection and align at the cores to allow light to pass through it. The use of fiber optic systems is expanding at an amazing rate. Only in the past Ten years, fiber optic communications systems have replaced just about all coaxial and twisted pair cables particularly in network backbones. This is also true in almost any long distance communication links.

This can be explained simply. **Optical fiber cable** is easier to set up, lighter than traditional copper cable, and much smaller than its electronic counterpart. The most crucial factor is it has much more bandwidth. Because fiber optic cables are lighter, they are simpler to survive existing ducts and cable raceways. There are other big benefits of fiber optic cables including their immunity to electromagnetic interference, longer repeater distances, lower power requirements, and better flexibility.

All the above pros make fiber optic cables very attractive and most important of all, very economical. The unstoppable trend for fiber optic applications would be the change from the long haul (long distance) to our desk, our house, and our office. The terms include FTTC ( fiber towards the curb), FTTD (fiber towards the desk), FTTH (fiber towards the home) and FTTB( fiber to the building). Fiber optic cables enable our imagine integrating all our phone, Internet and TV services. Fiber's wide bandwidth makes this possible. It offers more than enough ability to meet all our voice, data and video requirements.

The transformation from copper to fiber is greatly accelerated through the invention of **optical fiber amplifier**. Optical fiber amplifiers enable optical signal transmission over very long distances without the expensive procedure for conversion to electronic signals, electronic amplification and the conversion to optical signal again as in traditional regenerators.

Today most of the network traffic switching continue to be done by electronic switches such as those from Cisco. But tremendous interest and effort of utilizing all-optical devices for those network switching are accumulating in the industry. The most important sign of all-optical switching lies in its almost unlimited transmission capacity. However, it is still within the prototype stage for controlling light with light, so **optical switch** circuits continue to be controlled by electronic circuits now. The switching matrix may be optical circuits but the control are still done by electronic circuits.

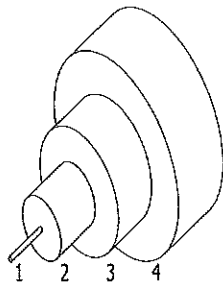
**Q3. What are the application of optical fiber communication system?**

**ANS:** Applications. Optical fiber is used by **telecommunications companies to transmit telephone signals, Internet communication and cable television signals**. It is also used in other industries, including medical, defense, government, industrial and commercial.

**Q4. What is core and cladding in optical fibers explain with diagram.**

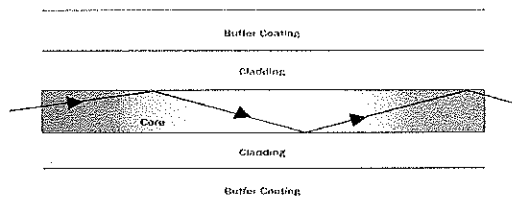
**Ans:** The **core** of a conventional optical fiber is the part of the fiber that guides the light. It is a cylinder of glass or plastic that runs along the fiber's length.<sup>[1]</sup> The core is surrounded by a medium with a lower index of refraction, typically a cladding of a different glass, or plastic. Light travelling in the core reflects from the core-cladding boundary due to total internal reflection, as long as the angle between the light and the boundary is greater than the critical angle. As a result, the fiber transmits all rays that enter the fiber with a sufficiently small angle to the fiber's axis. The limiting angle is called the acceptance angle, and the rays that are confined by the core/cladding boundary are called guided rays.

The core is characterized by its diameter or cross-sectional area. In most cases the core's cross-section should be circular, but the diameter is more rigorously defined as the average of the diameters of the smallest circle that can be circumscribed about the core-cladding boundary, and the largest circle that can be inscribed within the core-cladding boundary. This allows for deviations from circularity due to manufacturing variation.



1. Core 9 μm diameter
2. Cladding 125 μm dia.
3. Coating 250 μm dia.
4. Buffer or jacket 900 μm dia.

**Cladding** in optical fibers is one or more layers of materials of lower refractive index, in intimate contact with a core material of higher refractive index. The cladding causes light to be confined to the core of the fiber by total internal reflection at the boundary between the two. Light propagation within the cladding is typically suppressed for most fibers. However, some fibers can support *cladding modes* in which light propagates through the cladding as well as the core. Depending upon the quantity of modes that are supported, they are referred to as multi-mode fibers and single-mode fibers. Improving transmission through fibers by applying a cladding was discovered in 1953 by Dutch scientist Bram van Heel.



### Section – C

04X06 = 24 Marks

**Q1. Write a short note on (any four)**

- A. Connectors.
- B. Optical splicer
- C. LIU
- D. Power meter
- E. OTDR

**ANS: A.** An optical fiber connector **joins optical fibers**, and enables quicker connection and disconnection than splicing. The connectors mechanically couple and align the cores of fibers so light can pass.

**B.** OFC splicing machine is a **core-to-core alignment model**, used to carry out process of fusion splicing, a process of fusing or welding two fibers together usually by an electric arc.

**C.** Optical Fiber Liu is an **integrated unit for fiber management**, these equipment functions are to fix and manage the fiber optic cables inside the box as well as provide protection. ... Optical Fiber Liu is commonly used to fix and manage fiber optic cables inside the box.

**D.** When measuring fiber optic power with a power meter, **attach the meter to the cable. Turn on the source of power (transmitter), and view the meter's measurement.** Compare the meter measurement with the specified correct power for that particular system to be sure it doesn't have too much or too little power.

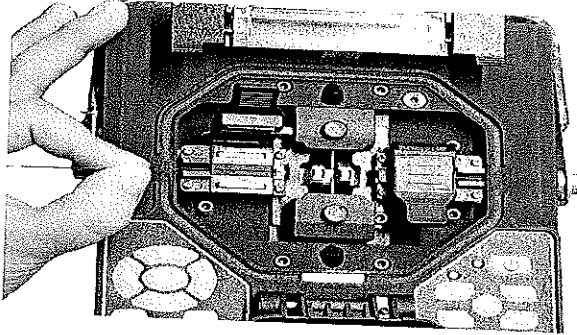


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**E. An optical time-domain reflectometer (OTDR)** is an optoelectronic instrument used to characterize an optical fiber. ... It injects a series of optical pulses into the fiber under test and extracts, from the same end of the fiber, light that is scattered (Rayleigh backscatter) or reflected back from points along the fiber.

**Q2. Write a note on fusion splicing method.**

**ANS:** Fusion Splicing is a permanent connection of two or more optical fibers. The two fibers are welded together with an electronic arc. This is the most widely used method of fiber optic splicing. Because it provides the lowest loss, less reflectance, strongest and most reliable joint between two fibers. When you adopt this method, fusion splicing machines are often used. Generally, there are four basic steps in the fusion splicing process. They are illustrated in following one by one.



### **Step 1: strip the fiber**

The splicing process begins with the preparation for both fibers ends to be fused. So you need to strip all protective coating, jackets, tubes, strength members and so on. And you just leave the bare fiber showing. It is noted that the cables should be clean.

### **Step 2: cleave the fiber**

A good fiber cleaver is crucial to a successful fusion splice. The cleaver merely nicks the fiber and then pulls or flexes it. So to cause a clean break rather than cut the fiber. The cleave end-face should be perfectly flat and perpendicular to the axis for a proper splice.

### **Step 3: fuse the fiber**

When you fuse the fiber, there are two important steps: aligning and melting. Firstly, you need to align the ends of the fiber within the fiber optic splicer. After proper alignment, you need to utilize an electrical arc to melt the fibers. So you can permanently weld the two fiber ends together.

### **Step 4: protect the fiber**

A typical fusion splice has a tensile strength between 0.5 and 1.5 lbs. And it is not easy to break during normal handling. However, it still requires protection from excessive bending and pulling forces. By using heat shrink tubing, silicone gel and mechanical crimp protectors can keep the splice from outside elements and breakage.

**Q3. What is the difference between single mode fiber and multimode fiber?**

**ANS:**

<b>Single-Mode Fiber</b>	<b>Multi-Mode Fiber</b>
Single-Mode Fiber uses a narrow glass core with one mode or pathway for transmitting light.	Multi-mode fiber uses a large diameter glass core which provides multiple modes or pathways for light to travel.

<p>Unlike multi-mode, single-mode doesn't have different light paths that reflect light off the cladding but instead has a single light beam. With no light reflection, there is less dispersion and therefore light signals can be transmitted over longer distances.</p>	<p>The multiple modes allow more light (essentially data) through the cable. However, at longer distances, the light will start to experience dispersion (distortion in light) which can limit data transmissions through unclear, incomplete signaling on the receiver end.</p>
<p><b>Characteristics of Single-Mode:</b></p> <ul style="list-style-type: none"> <li>- Small core diameter, 8 to 12 microns</li> </ul>	<p><b>Characteristics of Multi-Mode:</b></p> <ul style="list-style-type: none"> <li>- Larger core diameter, usually 50 – 100 Micrometers, (62.5 most common)</li> </ul>
<ul style="list-style-type: none"> <li>- Widely used cable in WAN networks today</li> </ul>	<ul style="list-style-type: none"> <li>- Widely used cable in LAN networks today</li> </ul>
<ul style="list-style-type: none"> <li>- More difficult and costly to terminate</li> </ul>	<ul style="list-style-type: none"> <li>- Easier to terminate</li> </ul>
<ul style="list-style-type: none"> <li>- Transmitters and receivers are more expensive</li> </ul>	<ul style="list-style-type: none"> <li>- Transmitters and receivers are more economical</li> </ul>
<ul style="list-style-type: none"> <li>- Typically used over long distances</li> </ul>	<ul style="list-style-type: none"> <li>- Used at shorter distances</li> </ul>

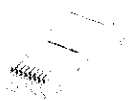
#### Q4. What are the 7 different types of cable connectors?

##### Connectors

With all the different types of cabling come a number of different cable connectors. This section takes a look at the most common cabling connectors.

##### Registered Jack 45 (RJ45)

The cable connector that is found on almost all UTP and STP cables is a Registered Jack 45 which is mostly commonly referred to as RJ45. This type of connector resembles the older RJ11 connectors that most people are familiar with from wired telephones. Figure 5 below shows an example of a RJ45 connector:



##### Straight Tip (ST)

The Straight Tip (ST) connector is often seen on the end of a multi-mode cable; it has been commonly seen along with the SC connector for the last 20 years but is being slowly replaced by multi-fiber connectors (LC and MTP). Figure 6 below shows an example of a ST connector:



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## Subscriber Connector (SC)

The Subscriber Connector (SC) can be seen commonly on MMF or SMF; as with SC connectors, the ST connector is slowly being replaced by multi-fiber connectors. Figure 7 below shows an example of an SC connector:



## Lucent Connector (LC)

The Lucent Connector (LC) was developed for high-density deployments where multiple fibers would be terminated within a confined space. Unlike the SC and ST connectors, the LC connector is always duplex connecting a pair of fibers at a time. Figure 8 below shows an example of a LC connector:



## Multi-fiber Push On (MPO)

The Multi-fiber Push On (MPO) connector is another duplex connector that offers an easy options for connection. As the name suggests, it was designed to be able to be connected multiple times without the creation of any potential connector issues. It is often also referred to as Multi-fiber Termination Push-on (MTP); the MTP connector is a brand name (US Conec). Figure 9 below shows an example of an MPO connector:





**School of Computing Skills  
Session: 2020-21 (Summer Semester)  
B. Voc. Program, III Semester,  
End-Sem. Examination**

**Course Code: ITN 1305  
Course Name: Optical Fiber Communication**

**Time: 2 Hour  
Max. Marks: 50**

**Section – A**

10X01 = 10 Marks

- Q1.** Which one of the following wavelengths is used by Multi Mode Fiber (SMF)?
- (A) 900 nm (B) 1900 nm  
(C) 1800nm (D) 1550nm
- Q2.** Main advantage of fiber optic cable over co-axial cable is.....
- (A) Easy handling (B) Less weight  
(C) Easy Testing (D) Low loss
- Q3.** Which one of the following is a multi-fiber connector?
- (A) ST (B) SC  
(C) MT-RJ (D) BICONIC
- Q4.** Which one of the following axis is used to displays distance in OTDR?
- (A) Horizontal axis (B) Vertical axis  
(C) No axis is used (D) Both axis is used
- Q5.** In a single mode of optical fiber \_\_\_\_\_
- (A) Bandwidth is higher (1000mHz) (B) Haul communication is long  
(C) V number is less than 2.405 (D) All of the above
- Q6.** The dimensions of core for multimode graded-index fiber is around \_\_\_\_\_
- (A) 100 to 500  $\mu\text{m}$  (B) 50 to 100  $\mu\text{m}$   
(C) 125 to 400  $\mu\text{m}$  (D) None of the above
- Q7.** What are the signals that are used to modulate high-frequency electromagnetic waves?
- (A) Radio wave (B) Microwave  
(C) Light wave (D) All of the above
- Q8.** An optical frequency rage starts from \_\_\_\_\_
- (A) 90THz-1000THz (B) 100THz-1000THz  
(C) 120THz-1000THz (D) 150THz-1000THz
- Q9.** Fiber optics was invented by.....
- (A) Thomas Mensah (B) Thomas Edison  
(C) John Henry Holmes (D) None of the above
- Q10.** Which component provides additional strength and prevents the fiber from any damage?
- (A) Core (B) Cladding  
(C) Buffer coating (D) None of the above



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## Section – B

04X04 = 16 Marks

- Q1. What are the advantages of Fiber Optics Cabling?**
- Q2. What are the different core/cladding sizes of optical fiber cable?**
- Q3. What are bending losses? Discuss**
- Q4. What are the different types of optical Fibers? Explain it.**

## Section – C

04X06 = 24 Marks

**Q1. Write a short note on.**

- A. Straight Tip (ST)**
- B. Subscriber Connector (SC)**
- C. Lucent Connector (LC)**
- D. Single Mode Fiber (SMF)**

- Q2. Draw a cross-section of a fiber optic cable and explain the purpose of each segment.**
- Q3. Write a short note on patch cord and pig tails.**
- Q4. What are the most common optical fiber cable problems?**



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Registration No.: .....

Set – B

School of Computing Skills  
Session: 2020-21 (Summer Semester)  
B. Voc. Program, III Semester,  
End-Sem. Examination

Course Code: ITN 1305  
Course Name: Optical Fiber Communication

Time: 2 Hour  
Max. Marks: 50

Instruction: (if any)

## Section – A

10X01 = 10 Marks

Q1. Which one of the following wavelengths is used by Multi Mode Fiber (SMF)?

- (A) 900 nm (B) 1900 nm  
(C) 1800nm (D) 1550nm

ANS: (A)

Q2. Main advantage of fiber optic cable over co-axial cable is.....

- (A) Easy handling (B) Less weight  
(C) Easy Testing (D) Low loss

ANS: (D)

Q3. Which one of the following is a multi-fiber connector?

- (A) ST (B) SC  
(C) MT-RJ (D) BICONIC

ANS: (C)

Q4. Which one of the following axis is used to displays distance in OTDR?

- (A) Horizontal axis (B) Vertical axis  
(C) No axis is used (D) Both axis is used

ANS: (A)

Q5. In a single mode of optical fiber \_\_\_\_\_

- (A) Bandwidth is higher (1000mHz) (B) Haul communication is long  
(C) V number is less than 2.405 (D) All of the above

ANS: (D)

Q6. The dimensions of core for multimode graded-index fiber is around \_\_\_\_\_

- (A) 100 to 500  $\mu\text{m}$  (B) 50 to 100  $\mu\text{m}$   
(C) 125 to 400  $\mu\text{m}$  (D) None of the above

ANS: (B)

Q7. What are the signals that are used to modulate high-frequency electromagnetic waves?

- (A) Radio wave (B) Microwave  
(C) Light wave (D) All of the above

ANS: (D)

Q8. An optical frequency range starts from \_\_\_\_\_

- (A) 90THz-1000THz (B) 100THz-1000THz  
(C) 120THz-1000THz (D) 150THz-1000THz

ANS: (B)

Q9. Fiber optics was invented by.....

- (A) Thomas Mensah (B) Thomas Edison  
(C) John Henry Holmes (D) None of the above

ANS: (A)

Q10. Which component provides additional strength and prevents the fiber from any damage?

- (A) Core (B) Cladding  
(C) Buffer coating (D) None of the above

ANS: (C)

## Section – B

04X04 = 16 Marks



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## Q1. What are the advantages of Fiber Optics Cabling?

ANS: Advantages of Fiber Optics Cabling: -

Fiber optics has immense bandwidth capacity with potential speeds exceeding 100Gpbs. By default, it's considered to be a more secure form of communication media due to its glass fiber strands that make it extremely difficult to "eavesdrop" or "tap" without noticeable degradation. It can also be installed at long distances with estimates ranging from 1m up to 120km depending on the cable type. Fiber optic cabling is also resistant to electromagnetic interference, making it ideal for industrial environments and spaces with fluctuating power.

Fiber optic cabling offers many advantages over traditional cabling and is the preferred media for data links in industrial environments. When implementing fiber optics in an industrial environment, specialized industrial media converters such as serial to fiber converters may be needed to transmit data.

Fiber Optic cabling comes in two basic modes, Single-Mode and Multi-mode. While both modes have different characteristics and serve different purposes, their structural makeup is still the same; an inner core made of purified silica glass, an outer glass known as cladding, and protection by buffer or jacket. In extreme environmental conditions, specialized types of reinforced fiber optic cabling are used, this may involve interlocking or corrugated armored jackets.

## Q2. What are the different core/cladding sizes of optical fiber cable?

ANS: Core

- The *core*, which carries the light, is the smallest part of the optical fiber.
- Optical fiber cores are manufactured in different diameters for different applications. Typical glass cores range from as small as 3.7um up to 200um. Core sizes commonly used in telecommunications are **9um, 50um and 62.5um**. Plastic optical fiber cores can be much larger than glass. A popular plastic core size is 980um.

Cladding

- The *cladding* is surrounding the core and providing the lower refractive index to make the optical fiber work.
- When glass cladding is used, the cladding and the core are manufactured together from the same silicon dioxide-based material in a permanently fused state.
- The manufacturing process adds different amounts of dopants to the core and the cladding to maintain a difference in refractive indexes between them of about 1%.
- The coating is solely protective. It does not contribute to the light-carrying ability of the optical fiber in any way. The outside diameter of the coating is typically either **250um or 500um**. Generally, the coating is colourless. In some applications, however, the coating is coloured, so that individual optical fibers in a group of optical fibers can be identified.

## Q3. What are bending losses? Discuss

ANS:

The loss which exists when an optical fiber undergoes bending is called bending losses.

### Macro-bending Loss

Macro-bending happens when the fiber is bent into a large radius of curvature relative to the fiber diameter (large bends). These bends become a great source of power loss when the radius of curvature is less than several centimeters.

Micro-bendings are the small-scale bends in the core-cladding interface. These are localized bends can develop during deployment of the fiber, or can be due to local mechanical stresses placed on the fiber, such as stresses induced by cabling the fiber or wrapping the fiber on a spool or bobbin.

## Q4. What are the different types of optical Fibers? Explain it.

ANS: The types of optical fibers depend on the refractive index, materials used, and mode of propagation of light.

The classification based on the refractive index is as follows:

- **Step Index Fibers:** It consists of a core surrounded by the cladding, which has a single uniform index of refraction.
- **Graded Index Fibers:** The refractive index of the optical fiber decreases as the radial distance from the fiber axis increases.

The classification based on the materials used is as follows:

- **Plastic Optical Fibers:** The polymethylmethacrylate is used as a core material for the transmission of the light.
- **Glass Fibers:** It consists of extremely fine glass fibers.

The classification based on the mode of propagation of light is as follows:

- **Single-Mode Fibers:** These fibers are used for long-distance transmission of signals.
- **Multimode Fibers:** These fibers are used for short-distance transmission of signals.

The mode of propagation and refractive index of the core is used to form four combination types of optic fibers as follows:



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- Step index-single mode fibers
- Graded Index-Single mode fibers
- Step Index-Multimode fibers
- Graded Index-Multimode fibers

Section – C

04X06 = 24 Marks

**Q1. Write a short note on.**

- A. Straight Tip (ST)
- B. Subscriber Connector (SC)
- C. Lucent Connector (LC)
- D. Single Mode Fiber (SMF)

**ANS: A. Straight Tip (ST)**

The Straight Tip (ST) connector is often seen on the end of a multi-mode cable; it has been commonly seen along with the SC connector for the last 20 years but is being slowly replaced by multi-fiber connectors (LC and MTP). Figure 6 below shows an example of a ST connector:



**B. Subscriber Connector (SC)**

The Subscriber Connector (SC) can be seen commonly on MMF or SMF; as with SC connectors, the ST connector is slowly being replaced by multi-fiber connectors. Figure 7 below shows an example of an SC connector:



**C. Lucent Connector (LC)**

The Lucent Connector (LC) was developed for high-density deployments where multiple fibers would be terminated within a confined space. Unlike the SC and ST connectors, the LC connector is always duplex connecting a pair of fibers at a time. Figure 8 below shows an example of a LC connector:



**D. Single Mode Fiber (SMF)**

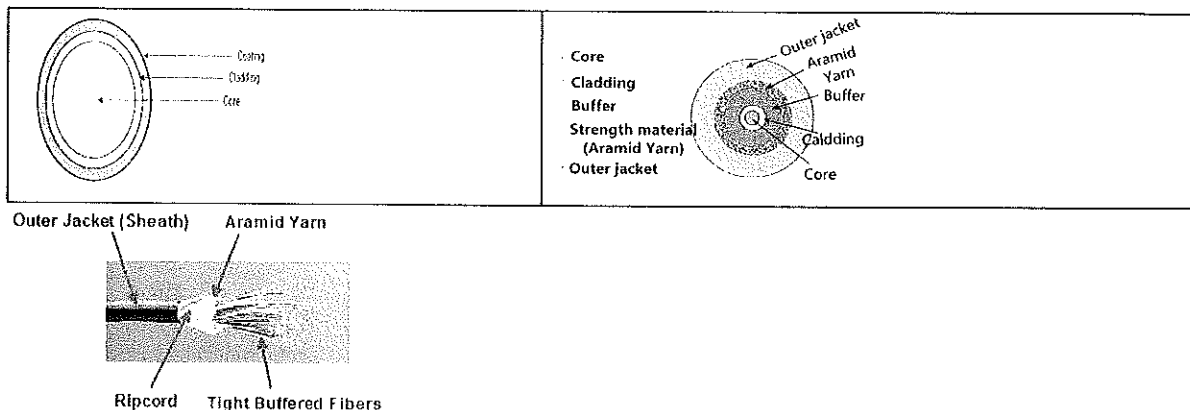
Single Mode Fibers (SMF) transmits signals via light and is not subject to electrical interference. The difference between SMF and MMF is in their physical characteristics; a MMF cable has a large core diameter and is able to accept a number of different modes that come into the cable from multiple angles, SMF has a much smaller core diameter (typically 8-10  $\mu\text{m}$ ) and accepts signals coming in from a specific angle and on a specific mode. The specifics of how the light propagate within the cable are really outside the scope of required knowledge of an entry level network engineer/administrator; what does

need to be known is that MMF is typically used for shorter cable runs (up to 2 km typically) and SMF can be used for cable runs of very long distances (typically up to ~40 miles without repeaters depending on wavelength).



**Q2. Draw a cross-section of a fiber optic cable and explain the purpose of each segment.**

**ANS: Optical fiber components:-**



A typical optical fiber comprises three main components: the core, which carries the light; the cladding, which surrounds the core with a lower refractive index and contains the light; and the coating, which protects the fragile fiber within.

### Core

- The *core*, which carries the light, is the smallest part of the optical fiber.
- The optical fiber core is usually made of glass, although some are made of plastic. The glass used in the core is extremely pure silicon dioxide (SiO<sub>2</sub>). In the manufacturing process, dopants such as germania, phosphorous pentoxide, or alumina are used to raise the refractive index under controlled conditions.
- Optical fiber cores are manufactured in different diameters for different applications. Typical glass cores range from as small as 3.7µm up to 200µm. Core sizes commonly used in telecommunications are **9µm, 50µm and 62.5µm**. Plastic optical fiber cores can be much larger than glass. A popular plastic core size is 980µm.

### Cladding

- The *cladding* is surrounding the core and providing the lower refractive index to make the optical fiber work.
- When glass cladding is used, the cladding and the core are manufactured together from the same silicon dioxide-based material in a permanently fused state.
- The manufacturing process adds different amounts of dopants to the core and the cladding to maintain a difference in refractive indexes between them of about 1%.

### Coating

- The *coating* is the true protective layer of the optical fiber.
- The coating absorbs the shocks, nicks, scrapes, and even moisture that could damage the cladding. Without the coating, the optical fiber is very fragile. A single microscopic nick in the cladding could cause the optical fiber to break when it's bent. Coating is essential for all-glass fibers, and they are not sold without it.
- The coating is solely protective. It does not contribute to the light-carrying ability of the optical fiber in any way. The outside diameter of the coating is typically either **250µm or 500µm**. Generally, the coating is colourless. In some applications, however, the coating is coloured, so that individual optical fibers in a group of optical fibers can be identified.

### Buffer

The main function of the buffer is to protect the fiber from damage.

### Jacket

Fiber optic cable's jackets are available in different colours that can easily make us recognize the exact colour of the cable we are dealing with. The colour yellow clearly signifies a single mode cable, and orange colour indicates multimode.

**Aramid Yarn** Aramid yarn is a yellow color, fiber looking material. It is strong and is used to bundle and protect the loose tubes or fibers in the cable. It is the strength member to provide tensile strength along the length of the cable during and after installation. When a cable is pulled into a duct, the tension is applied to the aramid yarn instead of the fibers.

**Central Strength Member** Many fiber optic cables has a central strength member, made of steel, fiberglass or aramid yarn. Central strength members are needed to provide the rigidity to keep the cable from buckling. Central strength members are common in outdoor cables and some high fiber counts indoor cables.

**Gel Compound** Gel compound fills buffer tubes and cable interiors, making the cable impervious to water. It needs to be completely cleaned off when the cable end is stripped for termination.

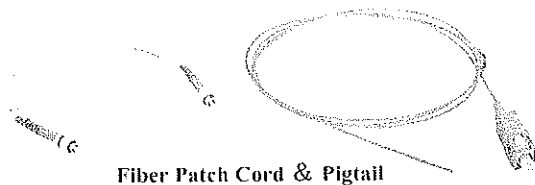
**Ripcord** Ripcord is a thin but very strong thread embedded just below the cable jacket. Its role is to split the cable easily without harming cable interiors.

**Q3. Write a short note on patch cord and pig tails.**

### Structures of Fiber Patch Cords and Pigtails

Fiber patch cord, also known as fiber optic patch cable or fiber jumper cable, is a short length of optical fiber cable with a connector on each end. Connector types on each side of the fiber patch cable can be different and they can also be the same.

Fiber optic pigtail is a piece of cable terminated with a fiber optic connector at only one end of the cable and leaves a length of exposed fiber at the other end, so that the connector side can link to the equipment and the other side can be melted with optical cable fibers or stripped and fusion spliced to a single fiber of a multi-fiber trunk. The following picture shows a fiber patch cord and a fiber pigtail.



Fiber Patch Cord & Pigtail

Fiber optic patch cords and pigtails structurally have much in common. They are both available in single mode and multi-mode, and they can be made into simplex and duplex. Besides, both fiber patch cord and pigtail can terminate with many kinds of fiber optic connectors, including FC, SC, ST, LC, MTRJ, MPO, MU, SMA, FDDI, E2000, DIN4, and D4.

The major physical difference between fiber patch cord and pigtail is that fiber patch cord is a fixed length piece of cable with fiber connectors on each end while fiber pigtail has fiber connectors on only one end of the cable. Fiber optic patch cords can be cut into shorter lengths to make two pigtails.

### Applications of Fiber Patch Cords and Pigtails

Fiber optic patch cords and pigtails provide interconnect and cross-connect of applications over installations in entrance facilities, telecommunications rooms, and data centers. They are available in OM4, **OM3**, OM2, OM1, or OS1/OS2 fiber types to meet the demands of Gigabit Ethernet, 10 Gigabit Ethernet and high speed Fibre Channel. However, they have their respective application areas, too.

Fiber patch cords are commonly used to connect ports on fiber distribution frames. They support network applications in main, horizontal and equipment distribution areas and are available in optical fiber riser cable (OFNR), and low smoke zero halogen (LSZH) rated jacket materials to comply with local cabling ordinances. They also support high speed (10/40 Gbs) telecommunications. Fiber optic patch cords can be used in many areas, such as integrated optics, laser detection and display, and materials processing.

Fiber optic pigtails support fusion splice field termination applications. They should be installed where they will be protected and spliced, so they are usually used with fiber optic management equipment like optical distribution frame (ODF), splice closures and cross cabinets. Pigtails are found anywhere, but most commonly in optical assemblages or optical components. There are waterproof fiber optic pigtails used for outdoor applications, which is with thick poly ethylene (PE) jacket and big diameter.

**Q4. What are the most common optical fiber cable problems?**

ANS: Common fiber cable problems

There are a number of problems that can affect fiber optic cable networks. Many of the most common problems are outlined below.

Attenuation/decibel (dB) loss.

All network transmissions degrade over distance. This is called attenuation, or decibel (dB) loss. This loss of signal strength can lead to slower speeds, loss or corruption of network traffic, or loss of the network communication link. The OTDR can diagnose attenuation and can also help in the placement of a repeater station.

*Highlights:*

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- The OTDR can diagnose attenuation and can help in the placement of a repeater station.

## **Broken fiber optic cable.**

As is the case with all types of cable media, fiber optic cables are subject to breakage. As a matter of fact, in some cases, they are more delicate than other types of media. A common cause of breaks in fiber optic cables is exceeding the bend radius limitations of the cable. Due to the construction of fiber optic cable, it is subject to breakage if it is bent beyond a certain point. Certain types of fiber cable can span many kilometers, often making it difficult to determine where a break has occurred. An OTDR can be used to determine where a break in the fiber optic cable has occurred, allowing a technician to insert a splice at that point.

### *Highlights:*

- As with all types of cable media, fiber optic cables are subject to breakage.
- An OTDR can be used to determine where a break in the fiber optic cable has occurred.

## **Bad small form-factor pluggable (SPF) or gigabit interface converter (GBIC) transceiver.**

It is possible for small form-factor pluggable (SPF) transceivers or for gigabit interface converter (GBIC) transceivers to go bad. The SPF and GBIC transceivers are hot swappable replaceable modules that are used to add gigabit capabilities to switches, routers, and other networking equipment. A bad transceiver will prevent communication from occurring. An OTDR can be used to help diagnose a bad SPF or GBIC module.

### *Highlights:*

- SPF and GBIC transceivers are hot swappable replaceable modules used to add gigabit capabilities to networking equipment.
- An OTDR can be used to help diagnose a bad SPF or GBIC module.

## **Fiber type mismatch.**

It is also possible to have a fiber type mismatch. Single-mode fiber (SMF) and multimode fiber (MMF) use different methods for placing the signal on the optic fiber. If a mismatch occurs, the most common problem is that it will be impossible to make a network connection. This problem can also be referred to as a wavelength mismatch, as the wavelength, or the color of the light being used, is different between the modes of fiber transceivers. The OTDR can be used to determine the types of transceivers that are being used.

### *Highlights:*

- SMF and MMF use different transceivers for placing the signal on the optic fiber.
- A wavelength mismatch will prevent a connection from being made.
- An OTDR can be used to determine the types of transceivers that are being used.

## **Other fiber optic cable issues.**

There are some additional fiber optic cable issues that can arise. Anything that can interrupt the flow of light from transceiver to transceiver will create a problem. Dirt or smudges on the connectors may cause an issue with fiber optic cable transmissions. When this is suspected, using a soft polishing cloth to clean the ends of the cable will solve the problem. However, technicians should exercise caution when doing so. It is important to never look directly into the ends of connected fiber optic cable, as eye damage can result.

Connectors are also specific to the mode of transmission, such as SMF or MMF. It is also important to check to make sure that the proper connectors are being used with the proper type of fiber optic cables. Connecting the wrong type of connector to a cable will prevent proper communication from occurring.

Worn or broken connectors will create an air gap, which will also create a network transmission problem. Connectors should always be inspected for their condition before being used. An OTDR can be used to determine where the loss of signal is occurring, even if it is at the connector.

### *Highlights:*



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- Anything that can interrupt the flow of light from transceiver to transceiver will create a problem.
  - Dirt or smudges on the connectors may cause an issue with fiber optic cable transmissions; a soft polishing cloth can be used to clean the ends of the cable.
  - Connectors are specific to mode of transmission—SMF or MMF.
  - Worn or broken connectors will create an air gap, which will create a network transmission problem; before using, always inspect connectors for their condition.
  
- An OTDR can be used to determine where the loss of signal is occurring.

