CBCS SCHEME

USN 15EC82

Eighth Semester B.E. Degree Examination, June/July 2019
Fiber Optics and Networks

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. With the help of neat diagram, explain the man blocks of an optical fiber communication link. **(10 Marks)**

b. Explain the advantages and disadvantages and applications of optical fiber communication system. **(06 Marks)**

OR

2 a. With the neat diagram, discuss the structure of single mode and multimode step index fiber with advantages for each type. **(08 Marks)**

b. A silica glass optical fiber has a core refractive index of 1.480 and the cladding refractive index of 1.460 (n_1 = 1.480, n_2 = 1.460) calculate critical angle, acceptance angle and numerical aperture and the number of guided modes at 1300nm if core radius is 20μm **(08 Marks)**

Module-2

3 a. Explain different absorption mechanisms in optical fibers. **(08 Marks)**

b. Explain linear and non-linear scattering losses in optical fibers. **(08 Marks)**

OR

4 a. Explain macro bending and micro bending losses with a neat diagram. **(06 Marks)**

b. Explain briefly about chromatic dispersion within an optical fiber. **(06 Marks)**

c. When the mean optical power launched into an 8 km length of fiber is 120 μw, the mean optical power at the fiber output is 0.3μw.

Determine :

i) The overall signal attenuation or loss in decibels thro' the fiber assuming that there are no connectors and splices.

ii) The signal attenuation per kilometer for the fiber. **(04 Marks)**

Module-3

5 a. Draw the diagram of a typical GaAlAS double Hetrostructure LED along with energy band diagram and refractive index profile and explain. **(10 Marks)**

b. Explain the terms :

i) Spontaneous emission

ii) Stimulated emission

iii) Quantum efficiency **(06 Marks)**

OR

6 a. Explain Fabry–Perot resonator cavity of laser with a neat diagram. **(06 Marks)**

b. Briefly discuss the possible sources of noise in optical fiber receiver. **(06 Marks)**

c. A GaAs laser operating at 850nm Los 560μm length and refractive index n = 3.7. What are the frequency and over length spacing's? **(04 Marks)**

Module-4

7 a. Explain the operational principle and implementations of WDM with diagram. (08 Marks)
b. Explain polarization independent Isolator with a neat diagram. (08 Marks)

OR

8 a. Explain optical circulators and optical add/drop multiplexers in detail. (06 Marks)
b. Explain the amplification mechanism in EDFA amplifier with the help of energy band diagram. (10 Marks)

Module-5

9 a. Explain about synchronous networks with STS frame structure. (08 Marks)
b. Describe about internet protocol and in evolution over physical layer evolution and traffic flow pattern with relevant diagram. (08 Marks)

OR

10 a. Explain with neat diagrams, Wavelength convertible routing network architecture. (08 Marks)
b. Write short note on optical fiber access networks and local are networks. (08 Marks)

* * * * *

AY: 2020-21

Department: Electronics & Communication Engg.
Semester / Division: 8TH (A&B)

Subject with Sub. Code: Fiber optics &network (17EC82)
Faculty Name: v.m.chougala

June/July 2019 — Module-1

Q No	Solution and Scheme	Marks
1 a.	With the help of neat diagram, explain the main blocks of an optical Fiber Communication link.	10 marks

>>

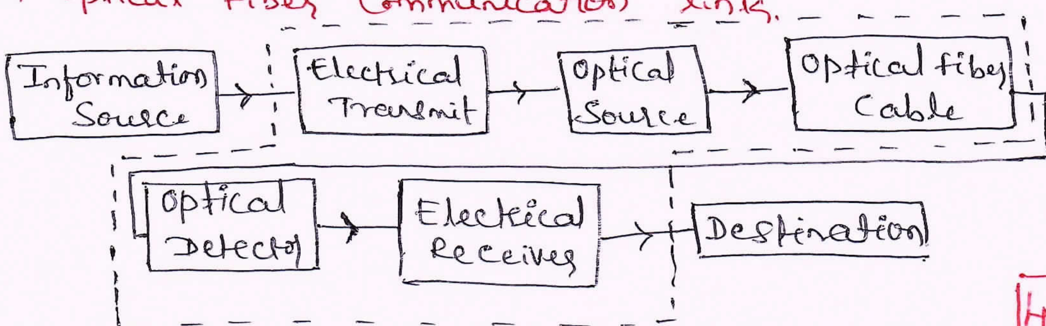

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Fig:- optical fiber Communication System.

* In optical fiber communication system as shown in fig, information source provides an electrical signal to a transmitter. Comprising an electrical stage which drives an optical source to give modulation of the light wave carrier. to give modulation of the lightwave carrier. optical source can be semiconductor laser or light emitting diode (Electrical-optical Conversion).
* Transmission Medium consist of an optical fiber Cable.
* Receiver Consist of an optical photodiode detector which is driven a Electrical stage & provides demodulation of optical signal & optical-electrical Conversion.
* optical Carrier may be modulated using either an analog or digital Information Signal. 6 M

6 Marks

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1b. Explain the advantages and disadvantages and appli-cations of optical fibre Communication System (06 marks)

>> Advantages of optical fibres Communication

* Enormouse potential Bandwidth: - 10^{13} to 10^{16} Hz
* Small size & weight.
* Electrical isolation :- optical fibers. which are fabricated from glass or plastic polymer are electric.
* Immunity to crosstalk and Interference :- optical fibers from a dielectric waveguide & are free from Electromagnatic interference (EMI).
* Signal security :- Light from fibers do not radiate significantly. & provide high degree of Signal Security.
* Low transmission Loss :- fibers have been fabricated with losses as low as 0.15 dBkm^{-1}.
* System Reliability & easy maintance.
* potential Low cost.

3M

Disadvantages :-

* High Investment Cost.
* Difficult to replace.
* Loss of light in fibes due to altenuation & dipersion.

Applications :-

* optical fibers used as Interconnects.
* These are used in Telephone networks, Cable television system (CATV)
* Military Applications and Defense.
* optical Sensor systems [measures Strain, Temperature Pressure].

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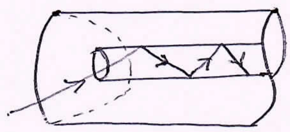
OR

2a.	With the neat diagram, discuss the Structure of Single mode and multimode Step index fiber with advantages for each type.	08 marks

>> i) Single mode fiber or monomode fiber.



* The single mode fiber supports only one mode of the propogation.

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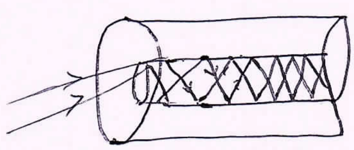
Advantages:-

* No Intermodel Dispersion.
* Higher Bandwidth.
* Easy fabrication.
* less manufacturing Expense.

Disadvantages:-

* Splicing is difficult.
* Requires high tolerance.
* Size of Core is Small so launching light into core of fiber is Complicated.

ii) Multimode Fiber:-



* multimode fibers Supports more than one mode of Propogation.
* Core radius is large.

Advantage:-

* Launching of light is easy.
* Splicing is easy
* Broad Source of light Can be used.

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Disadvantage:-

* Intermodal Despression.

Q5. A Silica glass optical fiber has a core refractive index of 1.480 and the cladding refractive index of 1.460 ($n_1 = 1.48, n_2 = 1.460$) Calculate critical angle acceptance angle and numerical aperture and the number of guided modes at 1300nm if core radius is 20μm. [08marks]

>> where

a) $\phi c = \sin^{-1} \frac{n_2}{n_1}$

$= \sin^{-1} \frac{1.460}{1.48}$

$= 80.56^{\circ}$ [4M]

b) from equation the numerical aperture is

$NA = (n_1^2 - n_2^2)^{1/2} = (1.48^2 - 1.46^2)^{1/2}$

$= (2.19 - 2.13)^{1/2}$

$= 0.03$

c) Consider Eq (2.8) the acceptance angle in air θ_a is given by

$\theta_a = \sin^{-1} NA = \sin^{-1} 0.03$

$= 1.71^{\circ}$ [4M]

Module - 2

3a. Explain different absorption mechanisms in optical fibers. (08marks)

>> There are three different Absorption mechanisms are there.

i) <u>Absorption by Atomic defects in glass Compotion.</u>

* Absorption loss Caused by automic defects are negligible. Compare to Intrensic & Entrensic methods
* This method becomes Significant if fiber is Exposed to ionizing radiation which occures in a nuclear reactor environment.
* Radiation damages a material by changing its internal structure.
* Damage effect depends on energy of ionizing particles or rays (Ex:- electron, newton), radiation flux (does rate) total close material Expressed in units or radius, which is measured of radiation absored in bulk Silicon.

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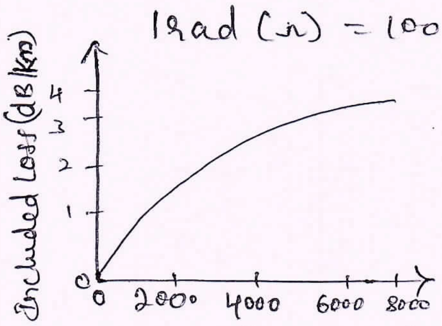
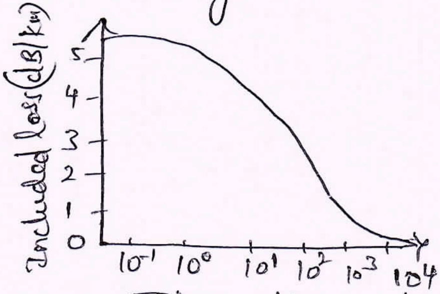
1rad (n) = 100 erg/g = 0.01 J/kg.



Dose (rad(si)).

a)



Time after radiations.

b)

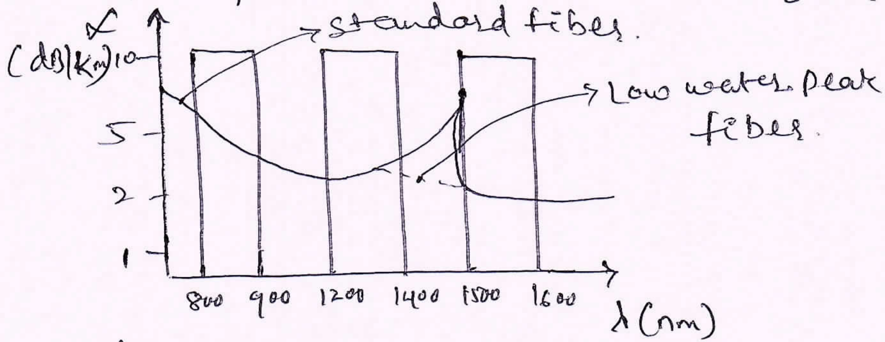
* Higher the radiation level, larger the attenuation as shown in fig a. The attenuation will relax or anneal with the time

ii) <u>Extensic Absorption Loss</u>:-

* Entrensic loss occurs either because of electronic transmission b/w energy level within these ions. or Charge transmission between ions.
* Absorption peak of various transmision metal impurities tend to be broad & reveral peaks may overlap. This furthere brods the absorption in specific region.

3a. ii) * modern vapour fiber technique for producing fibers have reduced the transistor metal impurities level by Several orders of magnitude.

* Low impurity level allows low loss fiber fabrication.

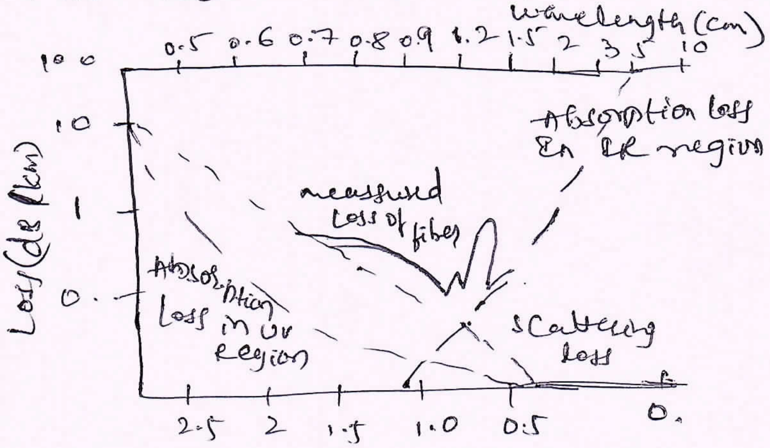


* By reducing off Content of fiber below 1ppb Single mode fibers have attenuation of 0.4 db/km at 1310nm & 0.25dB/km at 1550 m.

iii) Intrinsic Absorption:-

* It occurs when material is in a perfect state with no density variations, impurities material - inhomogeneties etc.

* Intrinsic absorption is due to:-
• Electronic absorption bands in ultraviolet region.
• Automative vibration bands in near infrared region.



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* Electronic absorption bands are associated with band gaps of amorphous glass material. Absorption occurs when a photon interacts with an electron in valence band & execute on higher energy level.

3b. Explain linear and non-linear Scattering losses in optical fibers. (08 Marks)

>> i) Linear Scattering losses :-

* The linear Scattering losses divides into 2 losses
i) Rayleigh Scattering ii) Mie scattering.

* In linear scattering, the optical power transferred it a different mode is proportional to power contained in the propogation mode.

* linear Scattering is Characterized by fact that there is no change in frequency of Scattered wave ∴ of transfer of power from the propagation mode. |2M|

Rayleigh Scattering :-

* Variation of RI within the glass over distance small compared with wavelength gives rise to Rayleigh scattering

* Rayleigh Scattering is inversely proportional to fourth power of wavelength ($1/\lambda^4$).

* The type of index variation causes light to be Scattered in all direction.

Mie Scattering :-

* When the Scattering inhomogeneity size is Comparable or greater than wavelength then mie Scattering is Significant & Scattering is in forward direction.

* The Inhomogeneities may be reduced by.
a) Removing imperfections due to glass manufacturing process
b) Careful controlled election & Coating of fiber. |2M|
c) Increasing the fiber guadiance by increasing relative refractive index difference.

ii) Non-Linear Scattering :-

The Non-linear Scattering losses divides into 2 losses.
i) Stimulated Brillouin Scattering.
ii) Stimulated Raman Scattering.

Vm

3b.>> **Stimulated Brillouin Scattering:-**

* SBS occurs from scattering of propagation light by thermal molecular vibrations of material. The interaction of photon with vibrating molecules of the material occurs in a phonon of acoustic frequency as well as a scattered photon of different energy. for SBS, the frequency shift is maximum in backward direction & zero in forward direction. SBS is veried as backword process.
* The threshold power required for SBS to occur depends on wavelength of operating wavelength & line width of optical source. [2M]

$$P_B = 4.4 \times 10^{-3} d^2 \lambda^2 \alpha_{dB} V \text{ watts.}$$

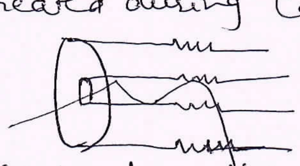
Stimulated Raman Scattering:-

* SRS is similar to SBS except that a high-freq optical photon is generated on scattering process.
* SRS occurs in both forward & Backward direction. In optical fiber & have an optical threshold of upto three orders of magnitude higher then Brillouin threshold into particular fiber.
* SRS threshold power $P_R = 5.9 \times 10^{-2} d^2 \lambda \alpha_{dB}$ watts
d & λ are measured in um. [2M]

4a. Explain macro bending and micro bending losses with a neat diagram. (06 Marks)

>> **Micro Bending:-**

* Microbends are Created by non-uniformaities on the manufacturing process of fibres & Lateral pressures Created during Cabling of fibres.



~~microbends are~~ Created by ~~non-uniformaities~~

* microbending "Loss α_m of jacketed fiber is reduced from that of an unjacketed fiber by a factor.

$$F(\alpha_m) = \left[1 + \pi \Delta^2 (b/a)^4 \frac{E_f}{E_j}\right]^{-2}$$ [3M]

where a = core radius of multimode graded
b = outer radius
Δ = Relative R.I index difference.

Nlugs
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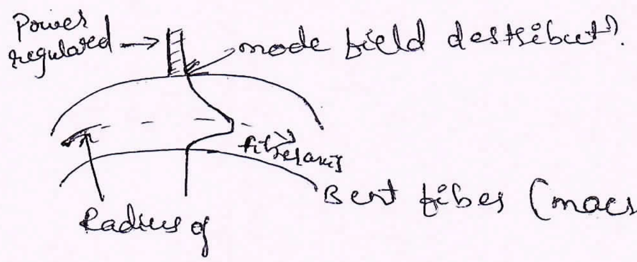
4a. >> Macrobending :-

* Macrobend occurs when a fiber is bent into a relatively large radius of curvature w.r.t fiber diameter. these bends can cause a significant power loss when radius of curvature falls below a certain critical value.
* Macrobends are formed when fibers are wound in the form of a spool or a fiber cable roll.
* Bending loss is primarily due to radiation of energy from fiber when evanescent field fails to keep up pace with part of mode varying harmonically in case as shown below.



Bent fiber (macrobending).

* A mode is considered as an electromagnetic field pattern created in transverse direction which varies harmonically in core region & decay exponentially in cladding region.
* A mode is considered to be bound when evanescent field to in the cladding region moves along with the part moving within core.
* when fiber is bent uniformly as shown in above figure, field tail on other side of the center of curvature is required to move faster relative to part on inner side incorded to keep part moving through core region.
* This is possible upto critical value of bending ~~below~~ decided by radius of radius of curvature of bending.
* Bending loss :- $\alpha_r = C_1 \exp(-C_2 R)$.
* Critical value of Radius curvature $R_C = \frac{3 n_1 \lambda}{4\pi(\sqrt{n_1^2 - n_2^2})}$
* Effective number of modes guided by a curved graded index fiber

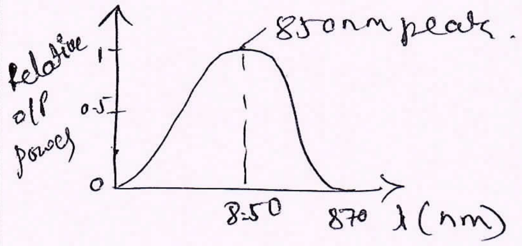
$$M_{eff} = M_{\infty}\left[1 - \frac{\alpha+2}{2\alpha\Delta}\left\{\frac{2a}{R} + \left(\frac{3}{2n_2 k R}\right)^{2/3}\right\}\right]$$

3M

4b. Explain briefly about chromatic dispersion within an optical fiber. (06 Marks)

>> * Chromatic or intramodal dispersion occures in all type of fiber & results from finite Spectral.

* There are two types of chromatic dispersion those are i) material Dispersion
ii) waveguide Dispersion.



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* Diagram Shows that a Source is emitting at 850nm peak with spectral width of 40nm.

* Intermodal dispression has high dependency on wavelength & Spectral width of Source.

* Material Dispersion occures when phase Velocity of a plane wave propagating in the dielectric medium varies non linerally with wavelength & $d^2n/d\lambda^2 \neq 0$.

* waveguide dispersion result from Variation in group Velocity with wavelength for particular mode fiber exhibits waveguide despersion when $d^2\beta/d\lambda^2 \neq 0$.

* with Single mode fiber waveguide depression are Significant.

4M

4C. When the mean optical power launched into an 8km length of fiber is 120μW. the mean Determine: (04 marks)

i) The overall signal attenuation or loss in decibels thro the fiber assuming that there are no Connectors and Splices.

ii) The Signal attenuation per kilometer for the fiber.

Solution :- Given $z = 8km$

$P(0) = 120 \mu W$

$P(z) = 3 \mu W$

1) overall attenuation is given by.

$$\alpha = 10 . \log \left[\frac{P[0]}{P[z]} \right]$$

$$\alpha = 10 . \log \left[120/3 \right]$$

$$\alpha = 16.02 dB.$$

2M

2) overall attenuation for 10km.

$$\text{Attenuation per km } \alpha_{dB} = \frac{16.02}{2} = \frac{16.02}{8} = 2.00 dB/km$$

Attenuation in 10km link = 2.00 x 10 = 20dB.

In 10km link there will be 9 splices at 1 km interval. Each Splice introducing at atten-uation of 1dB.

Total attenuation = 20dB + 9dB
= 29dB.

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Module-3

5a Draw the diagram of a typical GaAlAs double Heterostructure LED along with energy band diagram and refractive index profile and explain. (10Marks)

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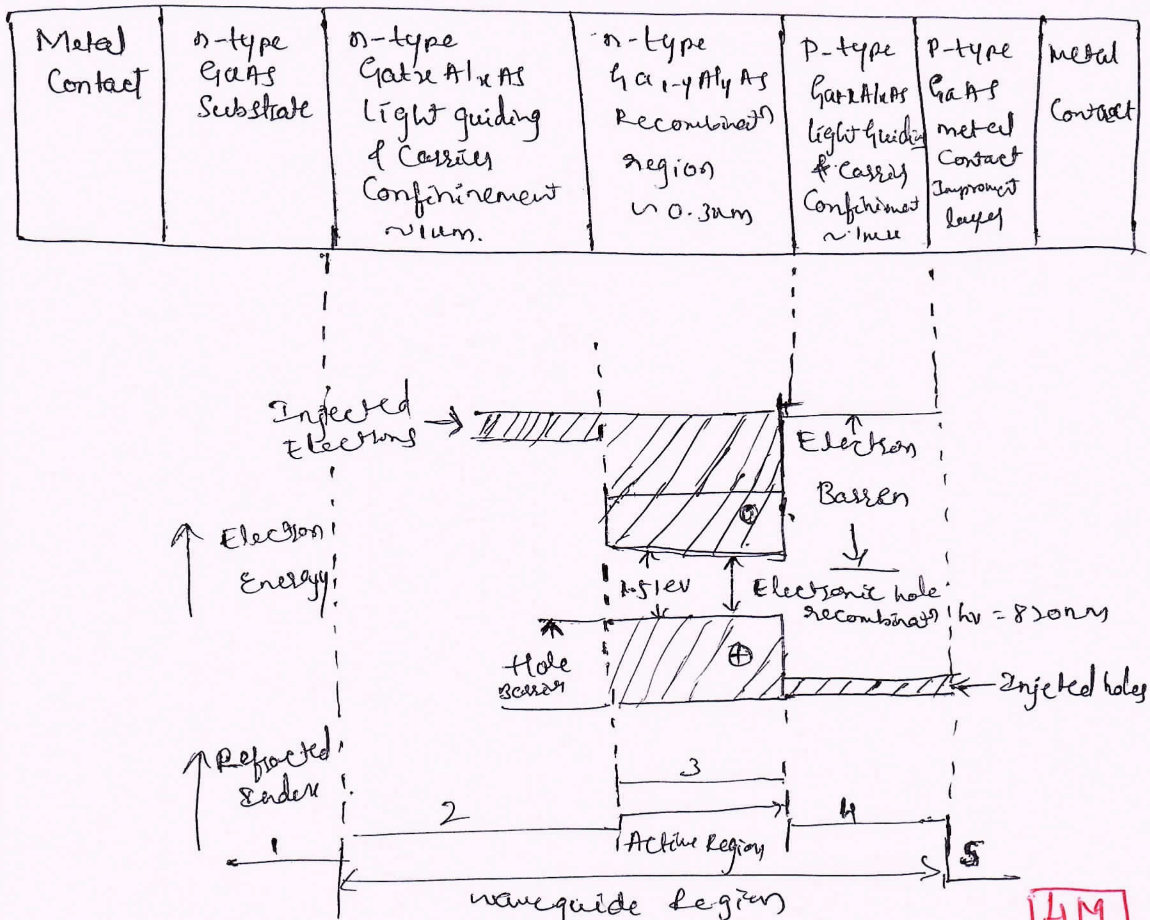

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Fig 1:- Cross section of typical GaAlAs double-heterostructure LED.

- Fig 1 Shows the double heterojunction Structure with two different alloy layers on each side of active region.
- Because of the Sandwich Structure of differently Composed alloy layers both Carriers and optical field are confined in central active layer.
- Band gap difference of adjacent layers provides Carrier Confinement.
- Difference in R.I. of adjacent layers provides optical Confinement.

6M

5b. Explain the terms:-
i) Spontaneous emission.
ii) Stimulated emission.
iii) Quantum efficiency. (06 marks)

i) Spontaneous emission:- Since this is an unstable state, the electron will shortly return to ground state. thereby emitting a photon of energy $h\nu_{12}$. This occurs without external Stimulation & is called Spontaneous emission.

ii) Stimulated emission:- The electron is immediately stimulated to drop to the ground state & gives off a photon of Energy $h\nu_{12}$. This Emitted photon is in phase with the incident photon & resultant emission is known as Stimulated emission.

3M

iii) Quantum efficiency:- The internal quantum efficiency in the active region is the fraction of electron-hole pairs that recombine radiatively. It is the ratio of radiative recombination rate to total recombination rate

$$\text{Quantum Efficiency} = \frac{\text{Ratio of radiative recombination}}{\text{total recombination.}}$$

3M

OR.

$$\eta = \frac{\text{no. of electron-hole pairs generated}}{\text{no. of incident photons.}}$$

6a. Explain Fabry-Perot resonatory Cavity of lasers with neat diagram

6a >>

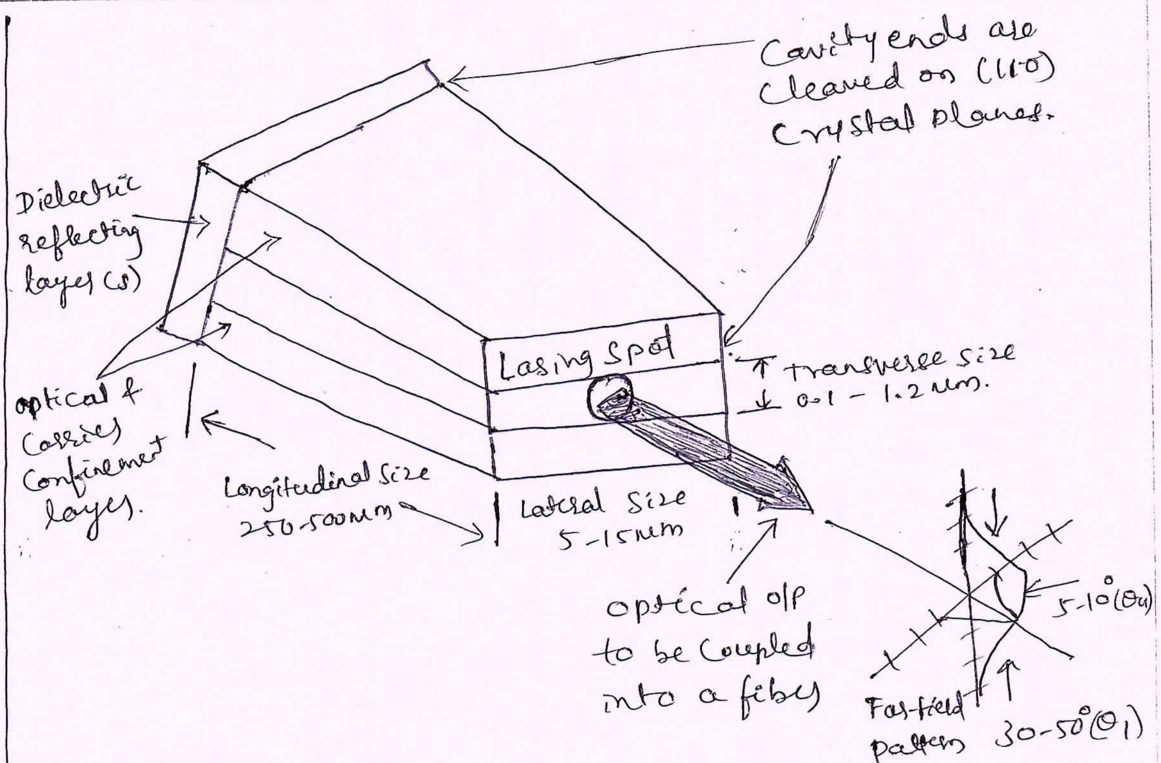
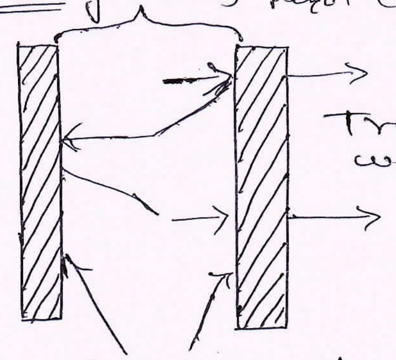


Fig:- Fabry perot resonator Cavity. 3M

* It is a laser diode configuration as shown in fig which generates radiation.
* The Cavity has the following small diameters
  longitudinal dimension: 250-500um long
  Lateral dimension : 5-15um wide
  Transverse dimension: 0.1-0.2 um thick.
* Resonator Cavity



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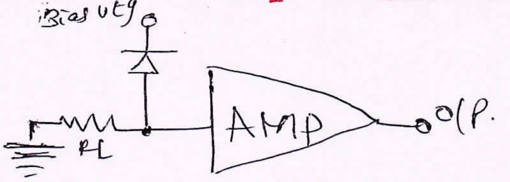
* Two flat partially reflecting mirrors are directed towards each other to enclose the fabry perot resonation cavity as shown in above figure
* mirror facts are constructed by making 2 parallel clefts along the natural cleavage planes of semiconductor crystal.

* Purpose of mirrors is to establish a strong optical feedback in the longitudinal direction.
* The unwanted emission in the lateral direction is avoided by roughing the edges of the device.
* Also the gain mechanism compensates for optical losses in cavity at resonant optical frequency.

6b. Briefly discuss the possible sources of noise in optical fiber receiver. (06marks)



(a) Photodetector Receiver. 2M

* Principle noises associated with photodetectors that have no internal gain are:
* Quantum noise
* Dark current noise generated in bulk material of photodiode
* Surface leakage current noise.

* The quantum or shot noise arises from the statistical nature of the production and collection of photoelectrons when an optical sig incident on photo-detector.
* The shot noise current have a mean-square value in a receiver bandwidth Be that is proportional to the average value of photocurrent Ip.
* The surface dark current is also referred to as a surface leakage current or simply the leakage current. it is dependent on surface defects, cleanliness, bias voltage & surface area

4M

6C. A GaAs laser operating at 850nm. Los 560um length and refractive index $n = 3.7$. what are the frequency and ones length spacing's? (04 marks)

Solution:-

The frequency spacing is

$$\Delta V = \frac{3 \times 10^{3}\, m/s}{2(500 \times 10^{-6} m)(3.7)} =$$

$$= 81\, GHz$$

The wavelength spacing is

$$\Delta \lambda = \frac{(850 \times 10^{-9} m)^2}{2(500 \times 10^{-6} m)(3.7}$$

$$= 0.195\, nm$$ 2M

Using equn (1) with $g(\lambda) = 0.5\, g(0)$ and then solving for σ with $\lambda - \lambda_0 = \Delta\lambda = 0.195\, nm$ yields

$$\sigma = \frac{\lambda - \lambda_0}{\sqrt{2 \ln 2}}$$

$$= \frac{0.195\, nm}{\sqrt{2 \ln 2}}$$

$$= 0.170\, nm$$ 2M

(signature) VMC

Module-4

7a. Explain the operational principle & implementations of WDM with diagram. (08 marks)

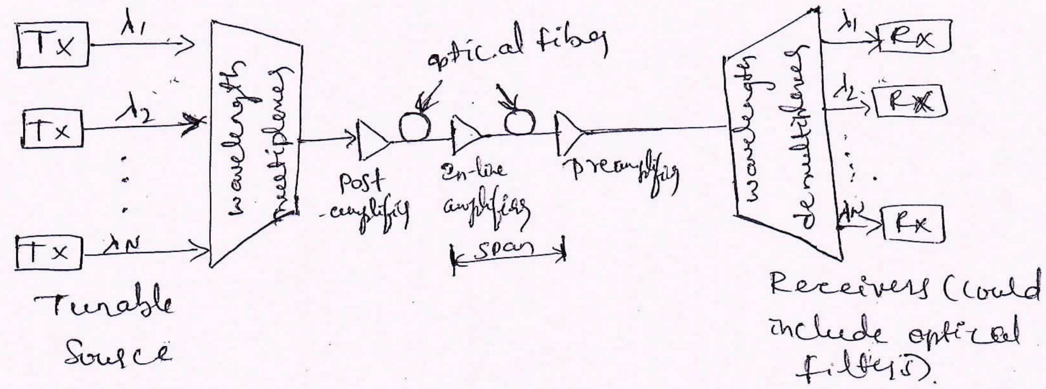


Fig:- Implementation of typical WDM network Containing various type of optical. [3M]

Overview of WDM operation principle

* Characteristics of WDM is that discrete wavelengths from an orthogonal set of carriers that can be separated, routed & switched without interfering with each other.

* Implementation of WDM network requires passive and Active devices to Combine distribute, isolate and & amplify optical power at different wavelength

* Passive devices:- Do not requires External Contain for their operation & limited in application flexibility Ex:- Splitter Combines etc.

* Active devices:- Require Control through electrically or optically Providing large degree of network flexibility Ex: Tunable optical filter, Amplitude etc.

Implementation:-

* Above figure shows Implementation of passive & active Components in a WDM link Containing various types of optical Amplifiers.

* multiplexer is needed to Combine these optical o/p's into a Continuous spectrum of Signals & Couple them onto a single fiber. [5M]

VMC

7a) * At receiving end a demultiplexer is required to separate the optical signals into appropriate detection channels for signal processing.

7b. Explain polarization independent Isolator with a neat diagram. (08marks)

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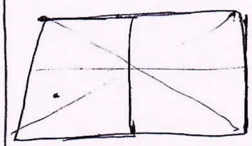

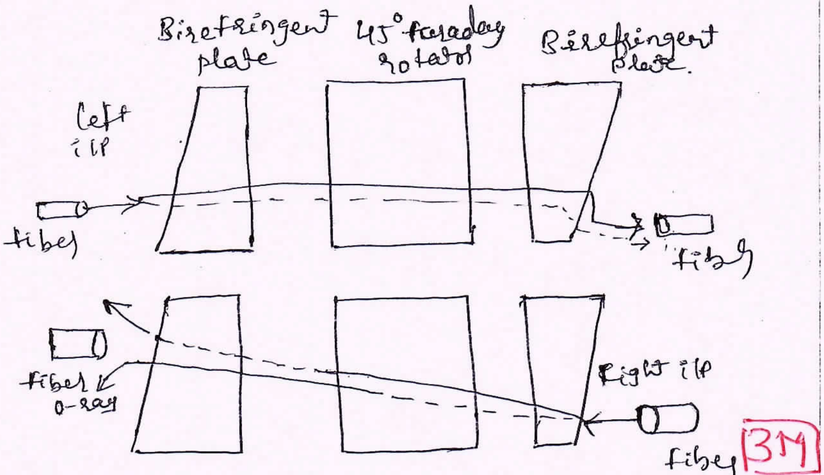

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* optical isolators are devices that allow light to pass through than in only one directions hence prevent scattered or reflected light from traveling in reverse - direction.
* Above figure shows a design for polarization - independent isolators made.
* Core of the device consists of 45° faraday rotator that is placed between two wedges - shaped birefri -ngent plates or walk off polarizers.
* plates are made of material YVO4 or TiO_2.
* light traveling in forward direction is separated into ordinary & extraordinary rays by first birefringent plate
* After exiting the rotator, two rays pass through second briefringent plate, the axis of this plate is oriented in such a way that relationship between the two types of rays is maintained.
* when rays exit the polarizer, they both refracted in identi -cal parallel direction.
* In reverse direction (right to left) the relationship of ordinary & extraordinary to ~~rotation~~ on & ~~rays~~ reversed due to non reciprocity of faraday rotation & rays diverge when then exit from left - hand birefringent plate & are not coupled to fiber anymore.

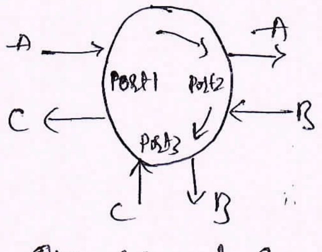
5M

VMC

20. Explain optical Circulators and optical add/drop multiplexers in detail. (06 Marks)

» Optical Circulator.

* An optical Circulator is a nonreciprocal multiport passive device that directs light sequential from port to port in only one direction.



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Operational Concept of three-port Circulator.

* As shown in above fig it consist of number of walk of polarizer, half wave plates & faraday rotation.
* Consider three port Circulator Hence i/p on port1 is sent out on port 2 an input on port 2 is sent out on port 3 & input on port 3 is sent out on port 1.
* In a four-port device ideally one could have four input & four output but in actual application four port making port 1 be an input port only 2 & 3 being input & output ports port 4 be are o/p.

~~Advantage:-~~

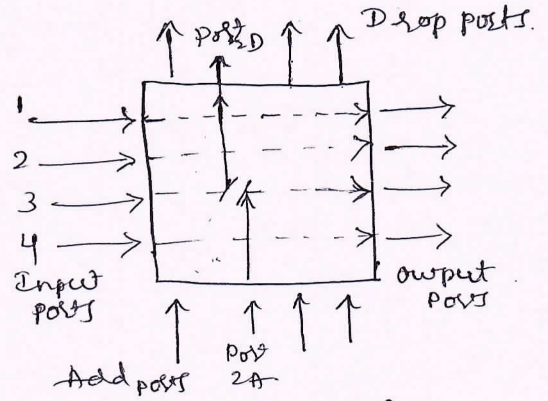
* Low insertion Loss.
* High isolation over wide wavelength range.
* Low polarization-mode depression

Optical Add/Drop Multiplexer (OADM)

* function of OADM is to insert (add) or Extract (drop) one or more selected wavelength at a designated Point in an optical network.

4M

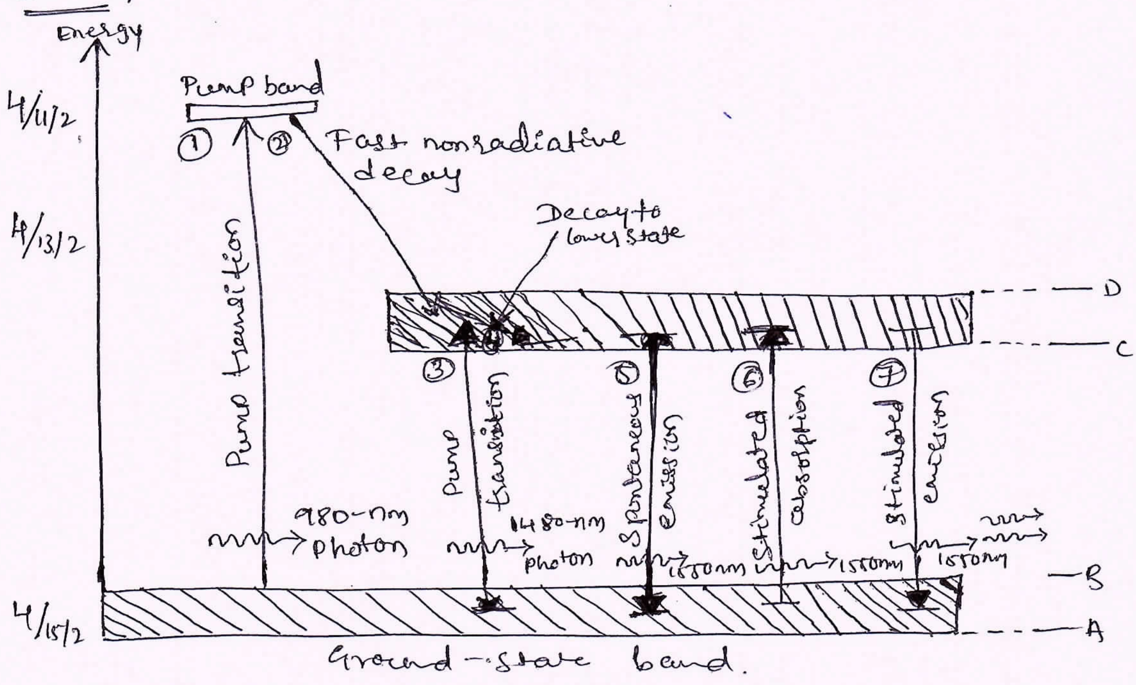
8a
>>



* Above figure shows a simple OADM which has four input & four output ports.
* In two case, add & drop function are controlled by MEMS based moveable mirrors that are activated separately & selectively to connect the desired fiber path.
* When no mirrors are activated, each incoming channel passes through switch to O/P port.
* Incoming signals can be dropped from traffic flow by activating appropriate mirror pair.

8b. Explain the amplification mechanism in EDFA amplifier with the help of energy band diagram. (10 Marks)

>> EDFA



Simplified energy-level diagrams and various transition processes of Er^{3+} ions in silica.

|4M|

8b» * The optical pumping process requires three or more energy levels.

* TO get a phenomenological understanding of how an EDFA works, we need to look at the energy level structure of erbium. 4.12-7.

* In describing the transitions of the outer electrons in these ions to higher level".

* Fig shows a simplified energy-level diagram & various energy-level transition processes of these Er^{3+} ions in silica glass.

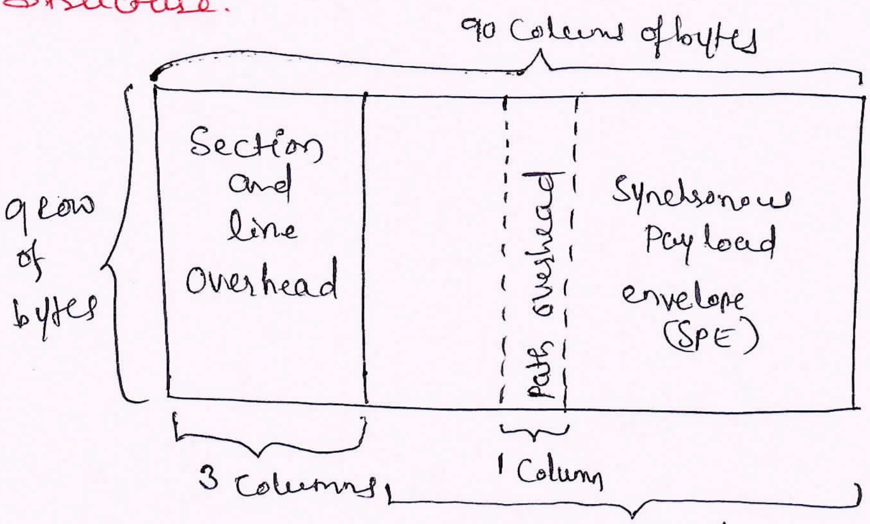
* The two principal levels for telecommunication applications are a metastable level (the so-called $^4I_{13/2}$ level) & the $^4I_{11/2}$ pump level. The term "metastable means that the lifetime for transitions from this state to the ground state are very long compared with the lifetimes of the states that led to this level.

* The pump band shown in the top left of the fig exists at a 1.27-eV separation from the bottom of the $^4I_{15/2}$ ground state. This energy corresponds to a 980-nm wavelength. 6M

Module - 5

9a. Explain about synchronous networks with STS frame structure. (08 marks)

>>



4M

Basic Structure of an STS-1 SONET frame.

9a) * This is called an STS-1 signal where STS stands for Synchronous transport signal. All other SONET sigs are integer multiples of this rate, so that an STS-N signal has a bit rate equal to N times 51.84 Mb/s.

* When an STS-N signal is used to modulate an opticle source the logical STS-N signal is first scrambled to avoide long strings of ones & zeros and to allow easier clock recovery at the receiver.

* After undergoing electrical to optical conversion the resultant physical layer optical sig is called OC-N where OC stands for optical carrier. It has become common to refer to SONET link as OC-N links. Algorithms have been developed for values of N ranging between 1 and 768. [4M]

9b. Describe about internet protocol and in evoluti-on over physical layer evolution and traffic flow pattern with relevant diagram. (08 Marks)

>> <u>Internet protocol.</u>

Layer	Name	Function	
Layer 7	Application	Provide general services eg. file transfer, user access	Responsibility of host system
Layer 6	Presentation	formats data (encodes, encrypts compress).	
Layer 5	Session	maintains dialog between communication device	
Layer 4	Transport	provides reliable end to end data transmission.	
Layer 3	Network	Switches and routes information units.	Responsibility of network
Layer 2	Data link	Provides data exchange between peer devices	
Layer 1	Physical	Transmits bit stream to physical medium	

Fig General Structure of 7 layer OSI model. [4M]

9b. *Physcical layer :- The physical layer refers to a physical transmission medium, such as a wire or an optical fiber, which can handle a certain amount of bandwidth. It provides different type of physical interfaces to equipment and its functions are responsible for actual transmission of bits across an optical fiber metallic wire.

* Datalink layer :- The purpose of data link layer is to establish, maintain and release link that directly connecte two nodes.

* Network layer :- The function of this layer is to delivery data packets from source to destination across multiple network link.

4M

* transport layer :- it is responsible for reliably delivering complete message from the source to destination.

* Higher layers (session, presentation, application) these all support user application.

10a. Explain with neat diagram. wavelength convertible routing networks architecture. (8marks)

>>

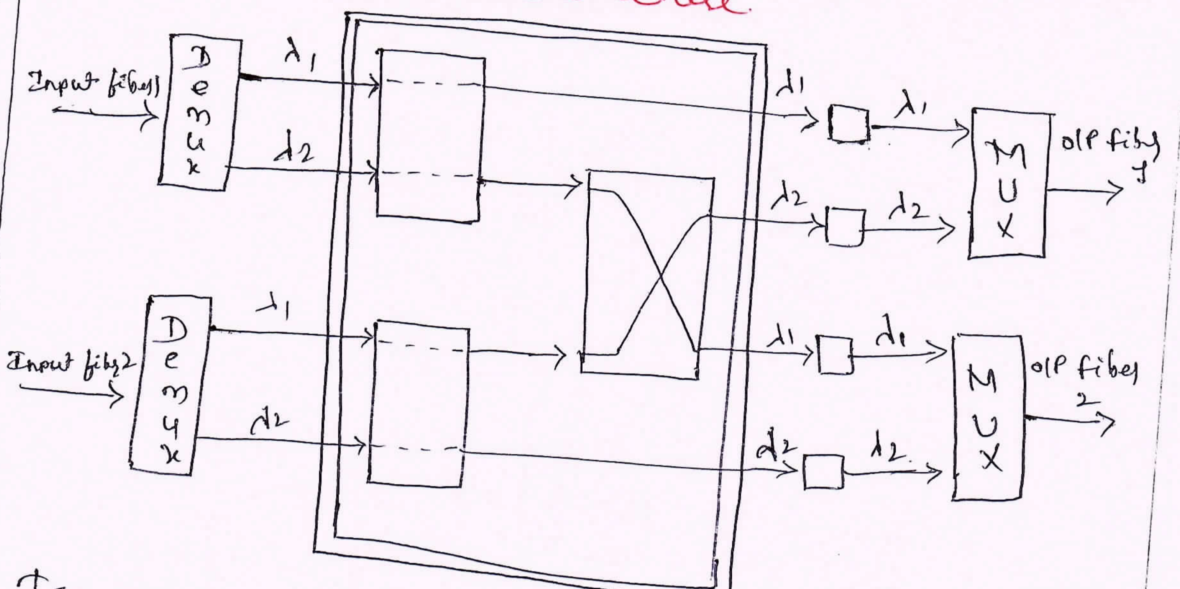


Fig 4x4 optical crossconnect architecture using optical space switching & wavelength converters.

4M

10a) Consider 4x4 OXC shown in fig. Here two i/p fibers are each carrying two wavelength. Either wavelength can be switched to any of the four o/p ports. The OXC consists of three 2x2 switches elements. Suppose λ_2 on i/p fiber 1 needs to be switched to o/p fiber 2 and that λ_1 on i/p fiber 2 needs to be switched to o/p fiber 1.

* This is achieved by having the 1st two switch elements set in bar state and the third elements set in the cross state as indicated in fig.
* Without wavelength conversion there would be wavelength contention at both output ports. By using wavelength converters the cross-connected lightwaves can be prevented from contending for the same o/p fiber.

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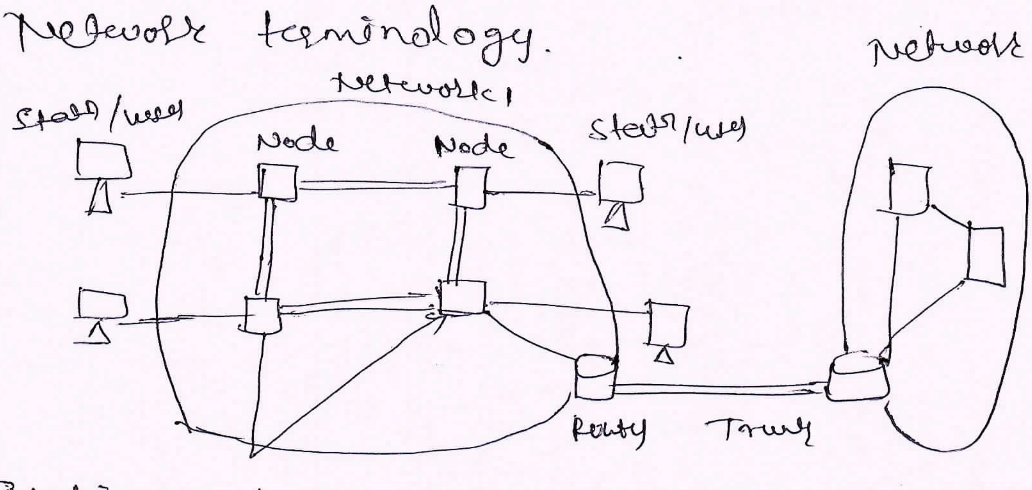
10b. Write a short note on optical fiber access Network and local Area network. (08 marks)

>> Optical fiber access Network

Network terminology.



Station :- devices that network subscribers used to communicate are called Station.

4M

106.) Networks :- To establish connections between Station.

Node :- it is a point where one or more communication line terminate and/or where Station are Connected

Trunk :- Trunk is transmission line that runs between nodes are linked together by information transmitting channel to form Network.

Topology :- The topology is logical manner in which nodes linked together by information - transmitting Channel to form a network.

Switching & Routing :- the transfer information from Source to destination through a series of inter -mediate node is called Switching.
and selection of a suitable path through a network is referred to as Rounting.

* LAN :- Local Area Network.

* A local area network (LAN) interconnects users in localized area such as a large room or work area, a department, a home, a building an office or factory complex or small group of buildings.

* A LAN employs relatively inexpensive hardware that allows user to share common expensive res -ources such as servers, high-performance printers specialized instrumention or other equipment.

* Etherent is the most Popular networking technology used in LANs.

* Local area networks usually are owned used and operated privately by a single organisation.

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