KLS Vishwanathrao Deshpande Institute of Technology

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

University / Model Question Paper
Scheme & Solution

Faculty Name	:	Prof. Rohini K / Sudheendra Yalagi
Course Name	:	Optical & Wireless Communication
Course Code	:	21EC72
Year of Question Paper	:	2024-25
Date of Submission	:	03/02/2025

Faculty Member

HoD

03.02.25

Dept. of Electronics & Communication Engg.

Dean (Acad.)

CBCS SCHEME

USN | 2 | V | D | 2 | 1 | E | C | 0 | 5 | 2 |

21EC72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Optical and Wireless Communication

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Briefly explain with a neat figure the propagation mechanism of meridional rays in an ideal step index optical waveguide. **(08 Marks)**

b. Define the term attenuation in optical fibers. Explain the different attenuation mechanisms in optical fibers. **(12 Marks)**

OR

2 a. Define Dispersion. Briefly explain intermodal and intramodal dispersion effects in optical waveguide. **(10 Marks)**

b. With neat figures, discuss the structure of single mode and multimode step-index and graded index optical fibers. **(06 Marks)**

c. A multimode fiber has a core refractive index of 1.480 and a core cladding index difference of 2.0 percent. Find the numerical aperture and critical angle at the core cladding interface. **(04 Marks)**

Module-2

3 a. What are the characteristic requirements of an optical source? With the help of neat diagram, explain the constructional features and emission pattern of surface emitting LED. **(10 Marks)**

b. Define optical isolator. With a neat figure, explain the design and operation of a polarization independent isolator. **(06 Marks)**

c. A given silicon avalanche photodiode has a quantum efficiency of 65 percent at a wavelength of 900 nm. If 0.5 μw of optical power produces a multiplied photocurrent of 10 μA. What is the multiplication M? **(04 Marks)**

OR

4 a. Discuss the operation of pin photodiode with a neat circuit and energy band diagram. **(10 Marks)**

b. What is Diffraction gratings? Discuss briefly Diffraction grating techniques. **(10 Marks)**

Module-3

5 a. Explain briefly the different propagation mechanisms that influence the signal propagation in a mobile communication environment. **(10 Marks)**

b. A cellular communication service area is covered with 12 clusters having 7 cells in each cluster and 16 channels assigned in each cell. Find the number of channels per cluster and the system capacity. **(03 Marks)**

c. Explain how the concept of frequency reuse increases the spectrum efficiency that intum increases the cellular communication system capacity. **(07 Marks)**

OR

6 a. Briefly discuss the generations of wireless communication network technology. (08 Marks)

b. Discuss the effects of co-channel interference in wireless communication in reducing the system capacity. (05 Marks)

c. Discuss the concept of multipath fading in mobile communication system. (07 Marks)

Module-4

7 a. With a neat block diagram, explain the operation of basic TDMA link. (10 Marks)

b. Explain the basic cellular system with necessary block diagram. (10 Marks)

OR

8 a. Discuss with a neat figure the call processing in a cellular system for mobile-originated calls. (12 Marks)

b. List the advantages of CDMA over TDMA and FDMA. (08 Marks)

Module-5

9 a. What is Hand off in GSM networks? Explain briefly the different handoff procedure in GSM. (10 Marks)

b. Explain the functions of data bases HLR and VLR at MSC in GSM network architecture and also explain how it is helpful in location updation in GSM networks. (10 Marks)

OR

10 a. Briefly explain the three major subsystems in GSM network architecture with a neat block diagram. (10 Marks)

b. Explain briefly the following identifiers in GSM system:

(i) SIM

(ii) Mobile system ISDN with frame format

(iii) Location Area Identify (10 Marks)

* * * * *

Module – ①

1) @ Briefly explain with a neat figure the propogation mechanism of meridional rays in an ideal ~~Sted~~ step index optical waveguide.

[Diagram – 4M, Explanation – 4M] [8 Marks]

Ans –

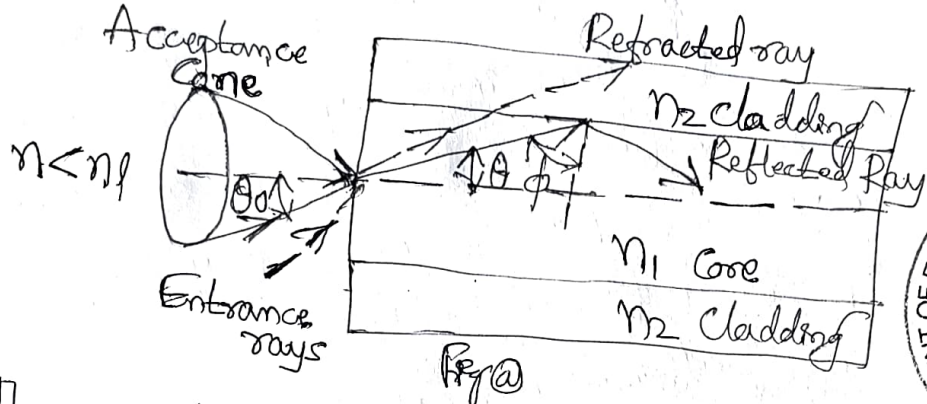


Fig @

The meridional ray is shown in fig @ for step index fiber, light ray enters the fiber core from a medium of RI n at an angle θ_0 wrt fiber axis and strikes the core–cladding interface at a normal angle ϕ. Meridional ray follows ~~Zig Zag~~ pattern along the fiber core after each reflection.

From Snell's law, the minimum critical angle ϕ_c that support total internal reflection is, $\sin\phi_c = \frac{n_2}{n_1}$ —— ①

rays striking the core–cladding interface at an ~~angle~~ angle less than ϕ_c will refract out of the core & be lost in the cladding. Now, due to this situation we have,

$$n \sin\theta_{0max} = n \sin\theta_A = n_1 \sin\theta_c = (n_1^2 - n_2^2)^{1/2} \quad \text{——} ②$$

Where $\theta_c = \frac{\pi}{2} - \phi_c$ hence θ_A defines acceptance cone, equation ② Also defines the Numerical Aperture (NA) of a step index fiber for ~~med~~ meridional rays.

$$\therefore NA = n \sin\theta_A = (n_1^2 - n_2^2)^{1/2} \cong n_1\sqrt{2\Delta} \quad \text{——} ③$$

Siyalogis...

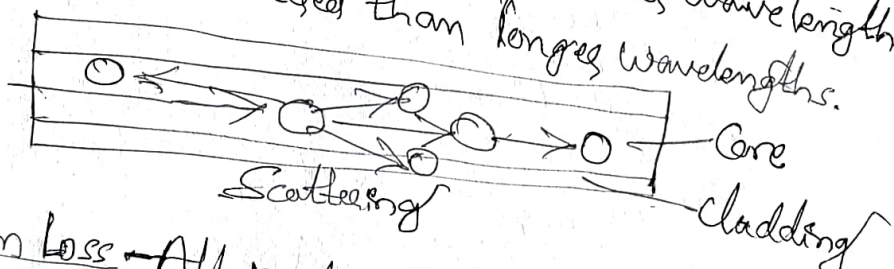
1(b) Define the term attenuation in optical fibers. Explain the different attenuation mechanisms in optical fibers. [12 Marks]

Ans – Attenuation in optical fiber can be defined as the loss of signal strength over a distance communication, Attenuation in optical fibers occures when the light intensity is reduced as it propogates through the fiber. It is the type of optical loss & limits the distance over which it can travel. It plays important role in design of optical fiber communication system.

→ Mechanisms of attenuation in optical fiber

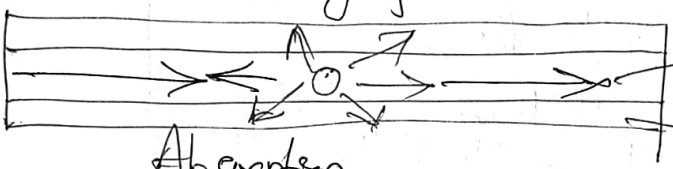
1. Scattering / Intrinsic Loss
2. Absorption / Intrinsic Loss
3. Bending / Extrinsic Loss

(1) Scattering Loss – It is due to intrinsic attenuation the light scattered in all directions, this is caused by automic structure and particles in the fiber that redirect the light that hits them. This is called Rayleigh Scattering. It depend on wavelength & size of the fiber. In optical fiber shorter wavelengths are more likely to be scattered than longer wavelengths.



(2) Absorption Loss – All materials including glass absorb some form of light, the amount of absorption depends on type of material and wavelength of the light passing through it. You can see absorption by sunglasses even on the brightest day only fraction of the light energy passes through tinted lenses

The wavelengths that cannot pass through are mostly absorbed by impurities that have been placed in or coated on lens material. Light travels best in clear substances. Impurities such as metal particles or moisture in the fibre can block some of the light energy, which will then gets absorbed. Absorption is the transformation of light into heat as it passes through dense medium. The solution is to use doparte chemicals during fibre manufacturing process.



(3) Bending Losses — These are a result of light being scattered and lost when it bends around corners. The more bends means more loss.

→ Microbending — When fiber optical cable is bent on a smaller scale typically at a radius of less than 1cm. When the cable is subjected to small changes in temperature, pressure or mechanical stress. this causes light travelling through the fibre to be scattered resulting in signal loss & reduced transmission quality.

These happens along the boundary layers between Core & Cladding caused by crushing or pressure these are often small & not visible when looking at the fibre cables.

→ Macrobending — When fibre optical cable bent on a larger scale typically of radius more than 1cm. When cable is subjected to more significant changes in temperature, pressure or mechanical stress. Both bendings have negative impact on optical fibers using of special Cable designs, cable cramps or trays are used to protect the fibre from such bending losses.

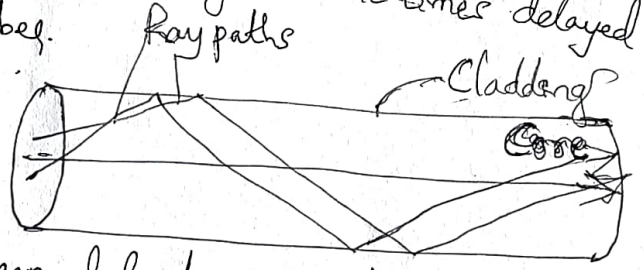
Dyalogue..

2) @ Define Dispersion. Briefly Explain Intermodal & Intramodal dispersion effects in optical waveguide [10 Marks]

Ans — Dispersion — The phenomenon where different wavelengths of light experience varying velocities as they travel through the fibers. It causes pulses of light to spread out over time. leading to signal degradation & limiting the transmission capacity of the fibers.

→ Intermodal Dispersion

This type of dispersion occurs in optical fibers because different light rays that propagate through a multimode fiber have different propagation delays. hence light shows dispersion due to easly reaching & some times delayed reaching the other end of fibers.



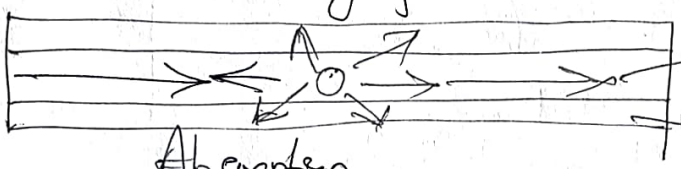
Intermodal dispersion where light rays propagate through different paths, hence these reaching time at the destination is different

→ Intramodal Dispersion

This type of dispersion occurs in optical fibers due to RI of the material varies when the light of different wavelengths propagates through the fiber as light wave consists of different wavelengths It is the combination of material & waveguide dispersion. As wavelength increases the Refractive Index (RI) of the material decreases. The effect is smaller as compared to intermodal dispersion. this causes the pulse spreading. resulting in loss of signal.

Analogue..

The wavelengths that cannot pass through are mostly absorbed by impurities that have been placed in or coated on lens materials. Light travels best in clear substances. Impurities such as metal particles or moisture in the fibers can block some of the light energy, which will then gets absorbed. Absorption is the transformation of light into heat as it passes through dense medium. The solution is to use dopant chemicals during fibers manufacturing process.



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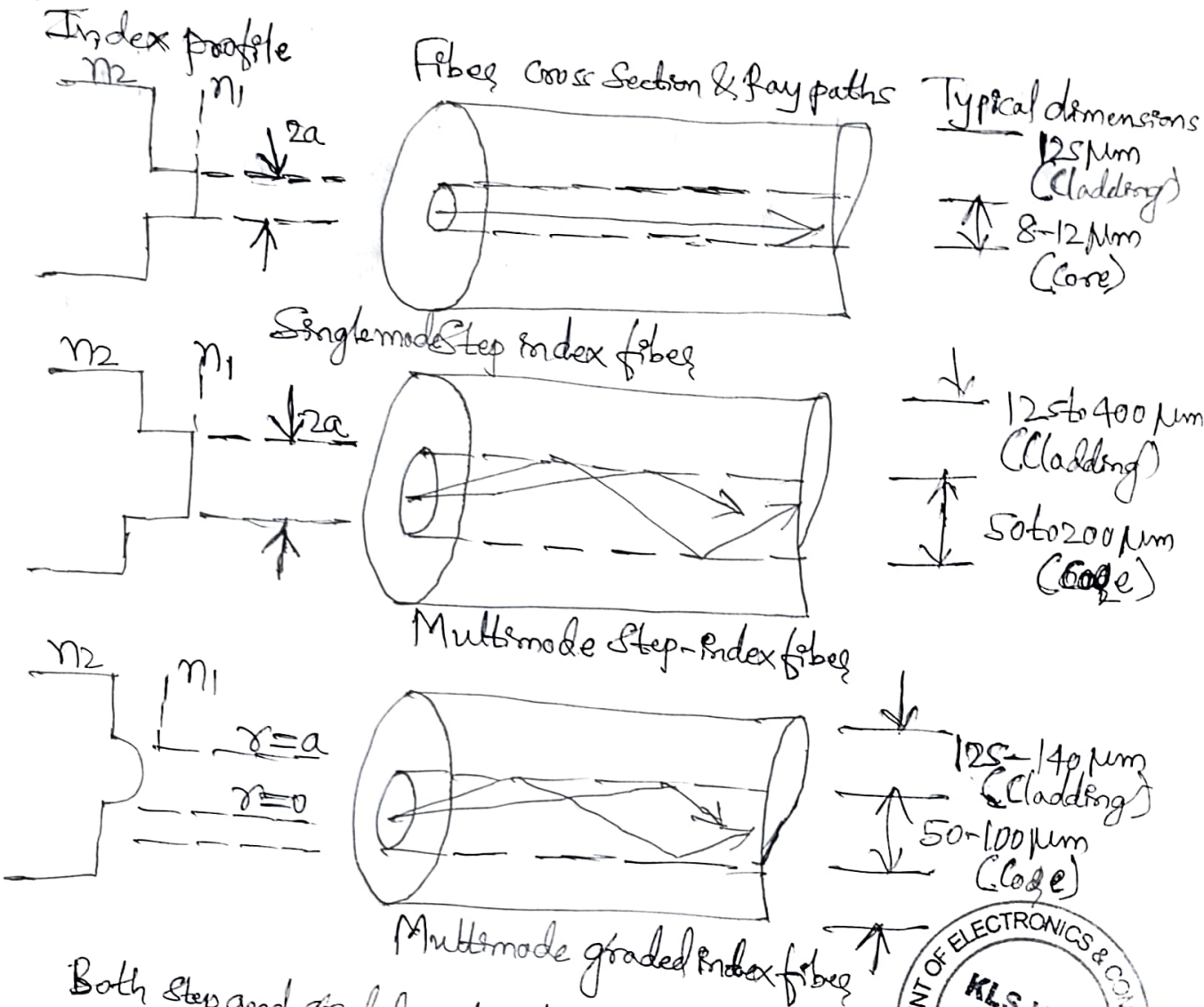
Gyalogue

2) (b) With neat figure discuss the structure of Single mode & multimode Step index & graded index optical fibers [6 Marks]

Ans—



Both step and graded index fibers are further divided into single mode and multimode classes. Single mode has only one mode of propagation, multimode fibers contains many hundreds of modes. multimode fibers provides more advantages as compared with single mode fibers. using LED source it is possible to launch light into multimode fibre core. they suffer from Intermodal dispersion.

Variation in the material composition of the core gives rise to two commonly used fibers in first case RI of core is uniform & changes at the cladding boundary called step index fibre. Second one is core RI is varied as function of distance from the center resulting in analogue.. graded-index fibre.

2) (C) A multimode fibes has a core refractive index of 1.480 and a core cladding difference of 2.0 percent. Find the numerical apestuse and critical angle at the core-cladding interface.

[Two masks each] [04 Masks]

Ans —

① $NA = n_1\sqrt{2\Delta} = 1.480\,(0.04)^{1/2} = 0.296$ (Numerical Apestuse)

② $\phi_c = \sin^{-1}\frac{n_2}{n_1} = \sin^{-1}(0.980) = 78.5^0$ (Critical Angle)

Module-②

3> @ What are the characteristics requirements of an optical source & With the help of neat diagram, explain the constructional features & emission pattern of surface emitting LED. [10 Marks]

[Explaination 6 Marks, Diagram - 4 Marks]

Ans — In choosing an optical ~~wave~~ source compatible with optical waveguide, various characteristics of fiber such as its geometry, its attenuation as a function of wavelength, its group delay distortion (bandwidth) & its modal characteristics must be taken into account.

Schematic of high radiance surface emitting LED

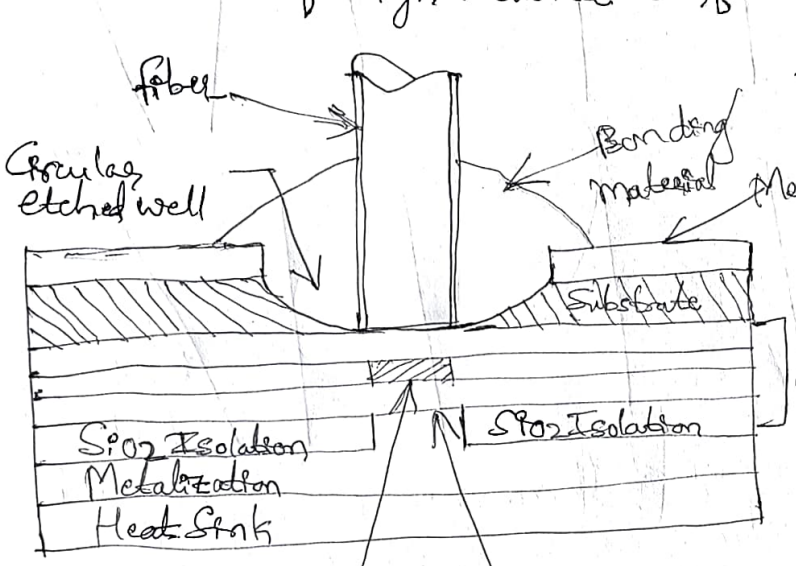


Fig ①

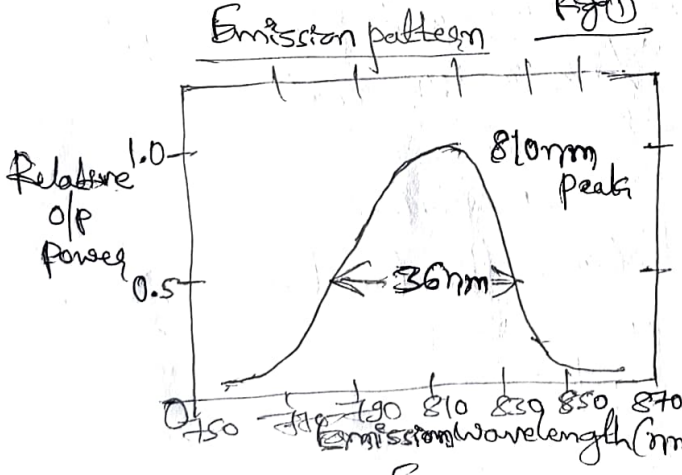


Fig ②

The two basic LED configurations are used for fiber optics are surface emitters & Edge emitters As shown in fig ① A well is etched through the substrate of the device into which a fiber is then inserted The active area for surface emitter is 50μm in diameter & 2.5μm thick As shown in fig ② the emission pattern Where Bandgap of 36nm is observed.

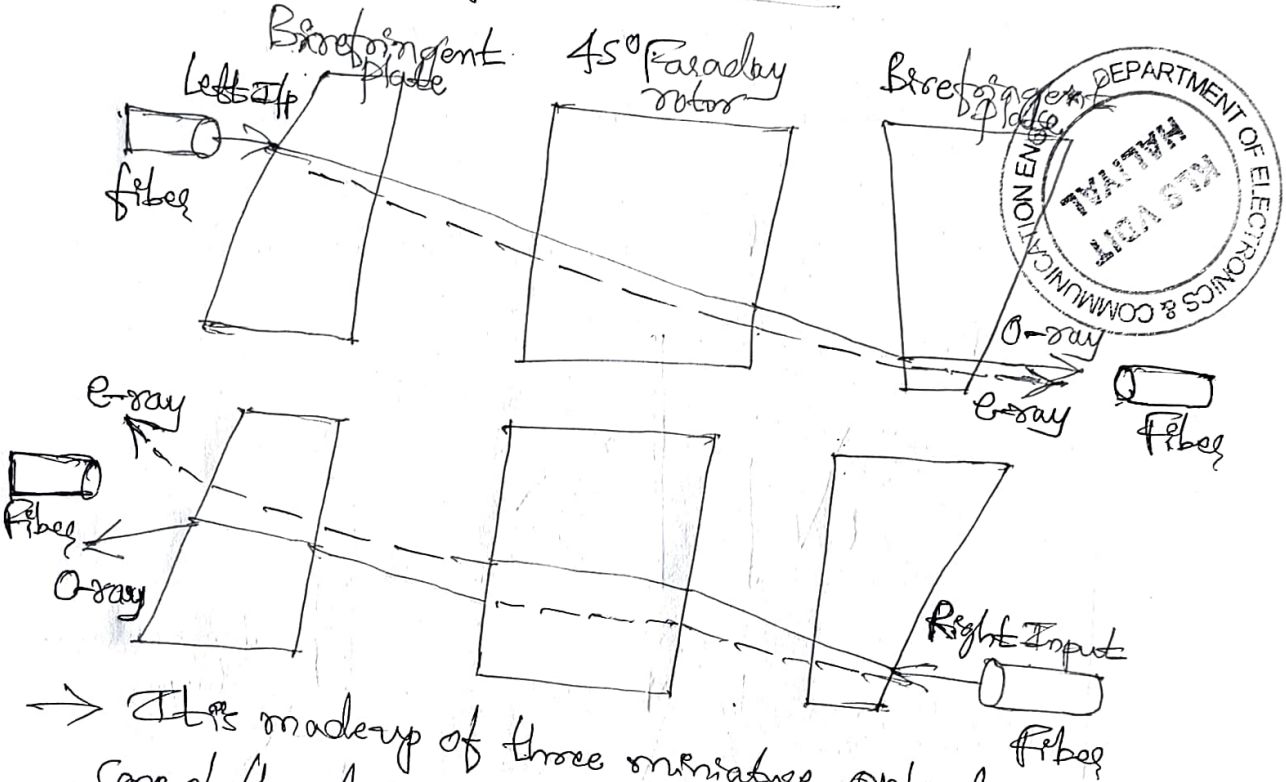
Signature

3) (b) Define optical isolator. With a neat figure, explain the design & Operation of a polarization independent isolator. [6 Marks]

[Theory (Explanation) — 3M, Diagram — 3M]

Ans — Optical Isolators — These are devices that allow light to pass through them in only one direction this is important to prevent scattered or reflected light from travelling in the reverse direction

→ Polarization Independent Isolator



→ It is made up of three miniature optical components. The Core of the device consists of 45° Faraday rotator that is placed between two wedge-shaped birefringent plates or walk off polarizers. These plates made up of YVO_4 or TiO_2 materials, two rays are produced ordinary ray (O-ray) & extraordinary ray (e-ray).

The axis of the polarizer plate is oriented in such a way that the relationship between the two types of rays is maintained, thus when they exit the polarizer, both are refracted in identical parallel direction, the relationship between O-ray & e-ray is reversed when exiting the Faraday rotator.

Gyalogue

3) © A given Silicon Avalanche photodiode has a quantum efficiency of 65 percent at a wavelength of 900nm. If 0.5μW of optical power produces a multiplied photo current of 10μA, what is the multiplication M?

[Finding I_p-2M, Finding M-2M] [4Marks]

Ans— The primary photo current is

$$I_p = R_{pm} = \frac{\eta q}{h\nu} P_m = \frac{\eta q \lambda}{hc} P_m$$

$$= \frac{(0.65)(1.6\times10^{-19})(9\times10^{-7})}{(6.625\times10^{-34})(3\times10^{8})} \times 5\times10^{-7}$$

$$I_p = 0.235\mu A$$

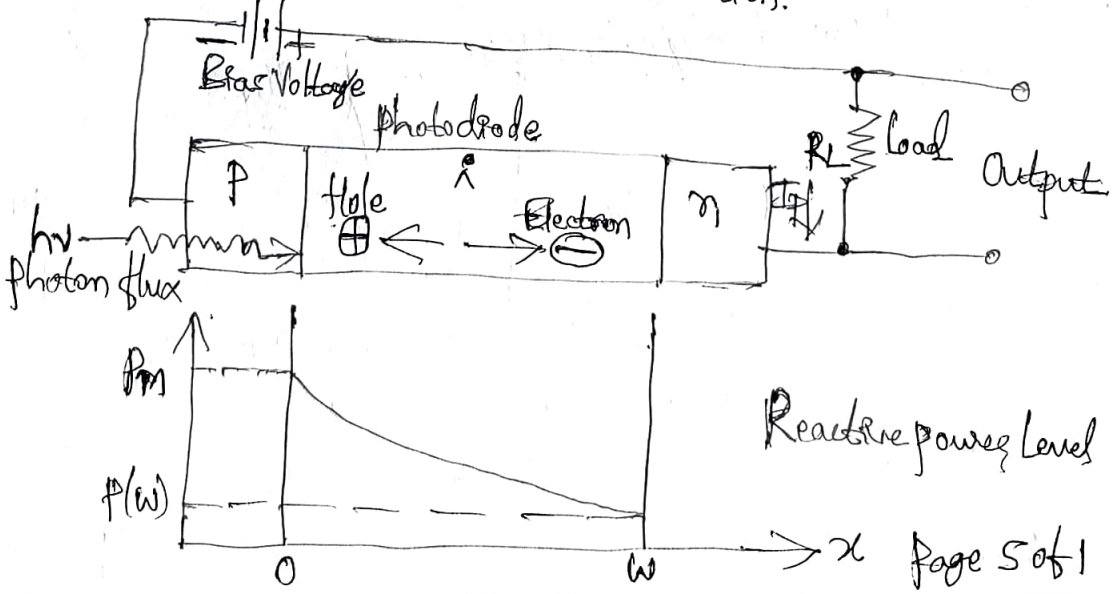
$$M = \frac{I_m}{I_p} = \frac{10\mu A}{0.235\mu A}$$

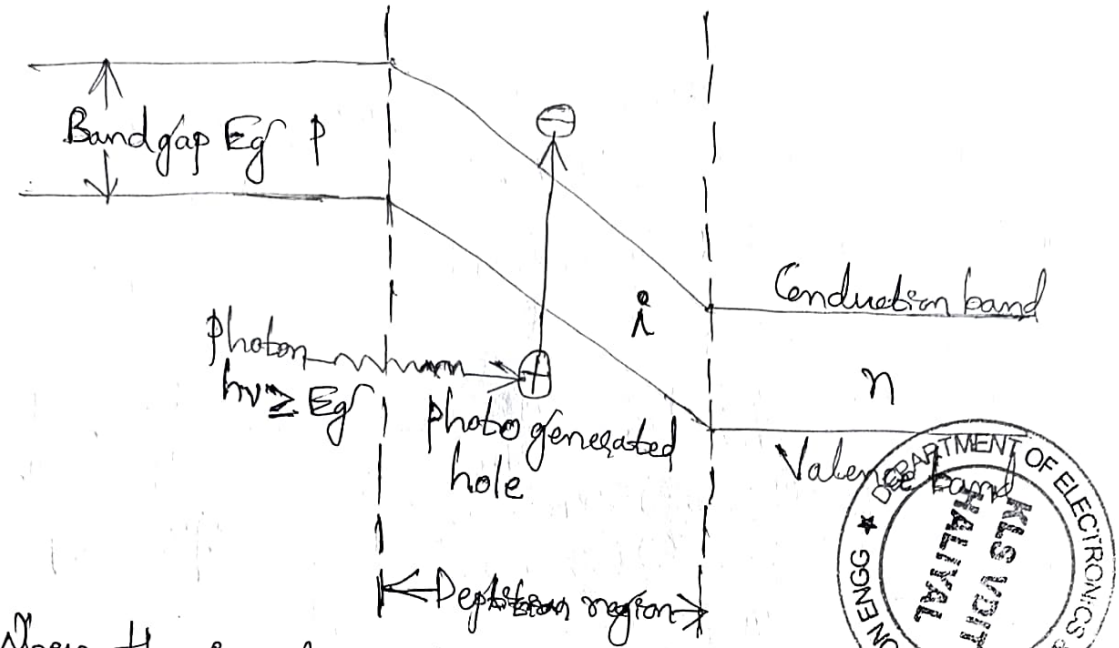
$$\therefore M = 43$$

4) @ Discuss the operation of pin photodiode with a neat circuit & energy band diagram.

[Explanation-4M, Diagram-6M] [10Marks]

Ans— pin photodiode is most widely used semiconductor diode. It consists of p & n regions seperated by lightely doped intrinsic region, large reverse biased voltage is applied across the device so that intrinsic region is fully depleted of carriers. The intrinsic n & p carrier concentration are negligibly small in comparision with impurities concentration.





When the incident photon has an energy greater than or equal to the bandgap energy of the semiconductor material the photon can give up its energy and excite an electron from two valence band to the conduction band. this generates electron-hole pairs these are called photo carriers. they produce current flow when bias Vbg is applied. these depends on concentration levels of impurities. on the average the charge carriers move a distance Ln or Lp for electrons & holes, this distance is know as diffusion length. The time it takes for an electron or hole to recombine is called as carrier life time (τn) & (τp). $L_n = (D_n \tau_n)^{1/2}$ & $L_p = (D_p \tau_p)^{1/2}$ Where Dn & Dp are electron hole diffusion coefficients.

4>(b) What is Diffraction gratings? Discuss briefly Diffraction grating techniques.

[Explanation 6M, Diagram 4M] [10 Marks]

Ans— A grating is an important element in WDM systems for combining & seperating individual wavelengths. Basically a grating is periodic structure in a material. This has the property of transmitting or reflecting light in certain directions.

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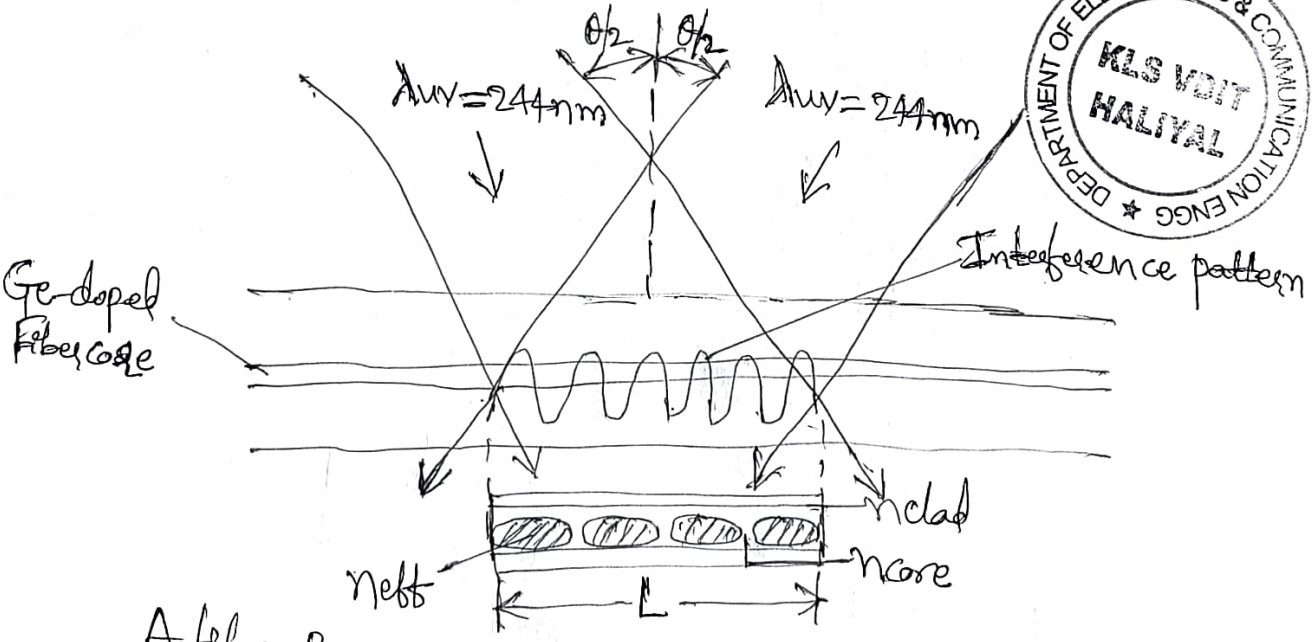
Syalaja

Gratings can be classified as either reflecting or transmitting

Various parameters are present for reflection grating, here θ_i is the incident angle, θ_d is the reflected angle, A – period of the grating. It consists of grating with equally spaced slits spacing b/w two slits is called pitch of the grating. grating equation is given by

$A(\sin\theta_i - \sin\theta_d) = m\lambda$ Where m – order of the grating & λ – wavelength

→ Fiber Bragg Grating

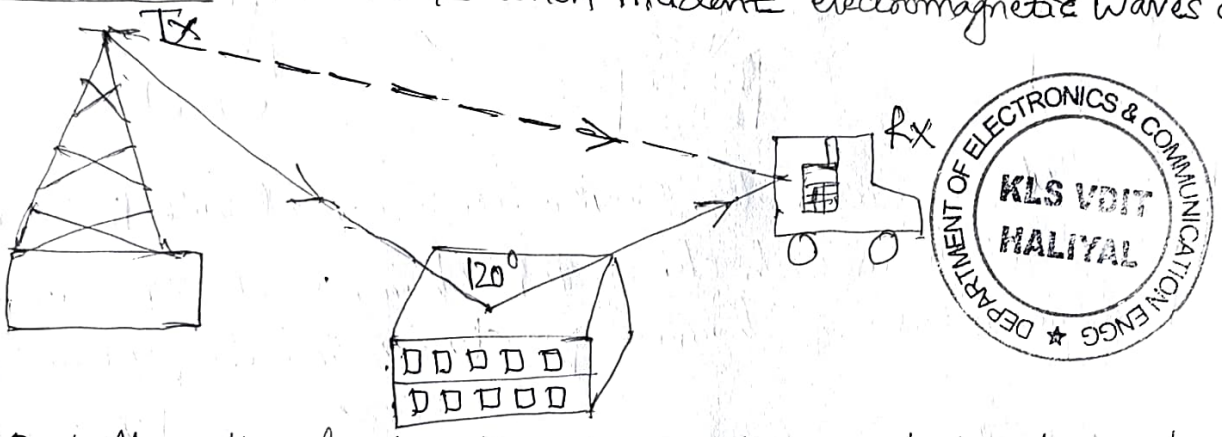


A fiber Bragg grating is a narrow band reflection filter that is fabricated through a photoimprinting process. One can induce the change in RI of the core by exposing it to UV radiation of 244nm.

5) @ Explain briefly the different propogation mechanisms that influence the signal propogation in a mobile communication environment.
[Diagram-4, Explanation-6] [10 Marks]

Ans — The three basic propogation mechanisms are
— Reflection
— Diffraction
— Scattering

① Reflection — It occures when incident electromagnetic waves are

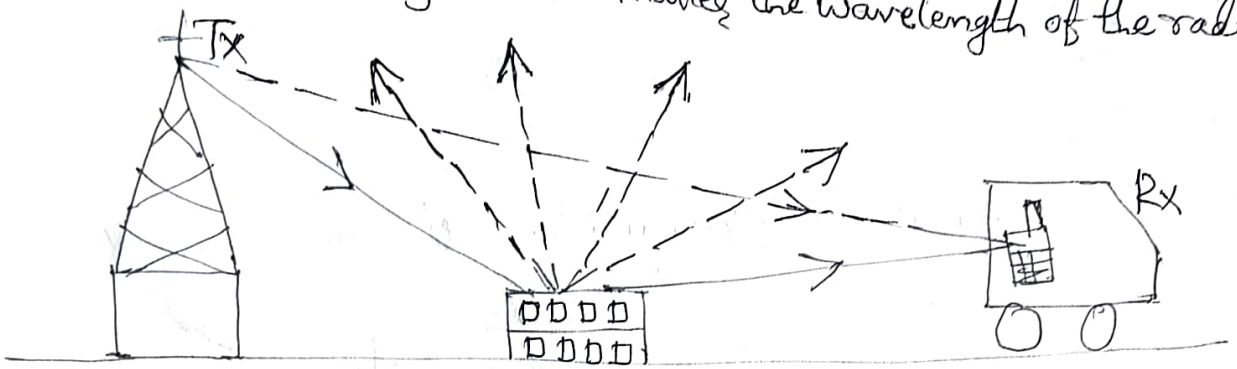


Partially reflected when they impinge (hit) on obstructions of different electrical properties objects such as surface of the earth, buildings, walls etc. The angle of reflection is equal to the angle at which the wave strikes the object. After reflection the signal strength of the radio wave gets reduced (attenuated).

② Diffraction — It is refered to the change in wave pattern caused by interferance between waves that have been reflected from a surface or a point. It is based on Huygen's principle which states that all points on a wavefront can be considered as a point sources for production of secondary wavelets that can combine to produce a new wavefront in the direction of propogation of signal.

Supriya...

③ Scattering — It is a special case of reflection caused by irregular objects such as walls with rough surfaces, vehicles, foliage, traffic signs, lamp posts etc. and results in many different angles of reflection & scattered waves in all directions in the form of spherical waves, hence scattering effect is difficult to predict. Scattering occurs when the size of the objects is smaller the wavelength of the radio wave.



5) (b) A cellular communication service area is covered with 12 clusters having 7 cells in each cluster & 16 channels assigned in each cell. Find the number of channels per cluster and the system capacity.

[03 Marks]

Ans — (1) To determine number of channels per cluster

No of channels per cluster = No of cells in a cluster × No of channels in a cell

= 7 × 16 = 112 channels/cluster

(2) To determine system capacity

System Capacity = Total clusters × No of channels/cluster

= 12 × 112 = 1344 channels/system.

5) (c) Explain how the concept of frequency reuse increases the spectrum efficiency that in turn increases the cellular communication system capacity.

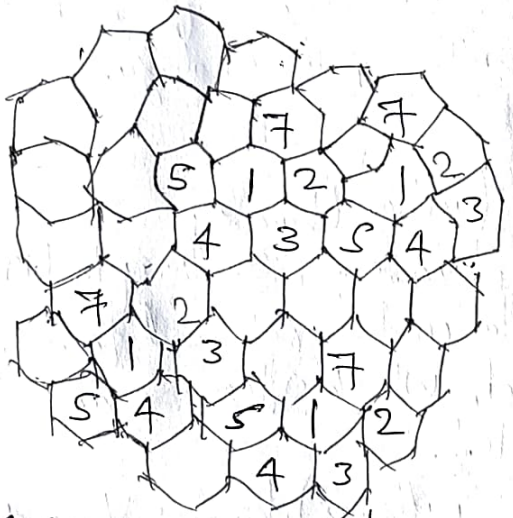
[Diagram - 3, Explanation - 4] [07 Marks]

Ans — The increase in system capacity is achieved with the use of smaller cells, reuse of frequency & cell sectoring.

Signaling...

Frequency reuse is a core concept of the cellular communication. The design process of selecting and allocating channel group for all the cellular base station within a system is called frequency reuse. hence large coverage area, efficient spectrum utilization & enhanced system capacity are the major attributes of cellular communication. However this require proper system design

A regular geometrical hexagonal pattern results in obtaining optimum area coverage & efficient spectrum utilization. Cells which use same set of frequencies, are refferred as co-channel cells. The space between adjacent co-channel cells is filled with other cells that use different frequencies to avoid interference. The typical cluster of 7 cells is shown in below figure.



The frequency reuse concept helps to serve more no of users thereby increasing the system capacity & hence enhancing spectrum efficiency as well.

6) @ Briefly discuss the generations of wireless communication network technology. [8 Marks]

[Explanation 2 marks each 4×2 = 8M]

Ans— ① First Generation — These relied on analogue radio systems, which means the users only make phone

Analogue...

Calls and not send or receive text messages
The 1G was first introduced in Japan in 1979 & in USA in 1980. Cell towers were built around the country to make it work. Signal coverage could be obtained from greater distances. The network was unreliable & had some security issues.

(2) Second generation (2G) — 1G remained until 1991 but it was not perfect, this was replaced by 2G which uses digital signal not analogue, improving its security & capacity on 2G users could send SMS & MMS messages

(3) Third generation (3G)
These are still in use, compared to 2G, 3G was much faster and transmits greater ammount of data Video call, share files, surf internet, watch TV online & play games on these mobiles first time. Social Connectivity comes with 3G technology.

(4) 4G (4th generation)
It went one step further than 3G
This 5 times faster than 3G, speed upto 100 Mbps can easily achieved. All mobile models released from 2013 onwards supports 4G network which offers seamless connectivity to laptops, tablets & PC's.
Better Latency (less buffering), higher Voice quality & faster downloads are the features of 4G.

6) (b) Discuss the effects of Co-channel Interferance in wireless Communication in reducing the system Capacity.
[Explanation 5 Marks] [5 Marks]

Ans — The frequency reuse method is useful for increasing efficiency of spectrum usage but results in Co-channel interferance, because the same frequency channel is used repeatedly in different co-channel cells.

Signalogue

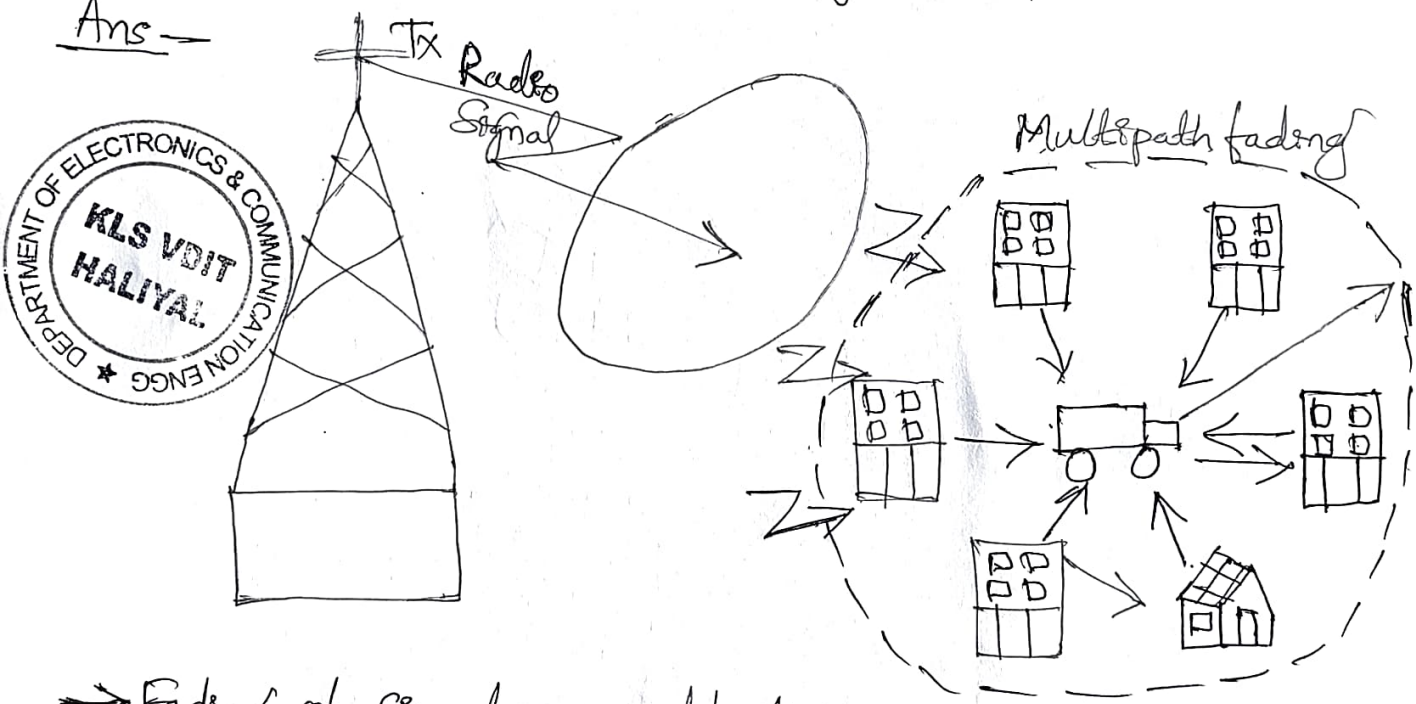
In this situation the received signal quality is affected by the amount of radio coverage area as well as the co-channel interferen -ce. The co-channel interferance is caused due to the reuse of the same carrier frequency at different geographical locations. Because co-channel interferance signals are amplified, processed & detected in the same manner as the desired signal. It may combine with the signal to cause distortion of the output. hence by reducing the total system capacity of the cellular network.

6) (c) Discuss the concept of multipath fading in mobile communication System.

[7 Marks]

[Explaination 4 Marks, Diagram - 3 Marks]

Ans —



→ Fading of signals received by the mobile unit is an inherent problem in mobile communication, as the location of the mobile unit keeps on changing in the real time, the resultant radio signal incident on its antenna varies continuously. Fading is the rapid fluctuation of a radio signals amplitude in a short time over short distance. When a mobile unit is stand still its receiver only receives signal strength at that spot hence const signal is observed. When mobile unit is moving multipath fading occures which becomes fast as vehicle moves faster.

Signalgue..

The fading occures due to two major phenomenon's

(1) Due to multipath time delay spread

(2) Due to Doples spread.

Addition of signals arriving via different paths reffered as multipath fading. The second caused by the relative movement of the mobile unit towards or away from the cell site transmitter is called Doppler effect.

Siyalagus

Module 4

7)a) With a neat block diagram, explain the operation of basic TDMA link. [10 Marks]

[Diagram - 4 , Explanation - 6]

Ans:

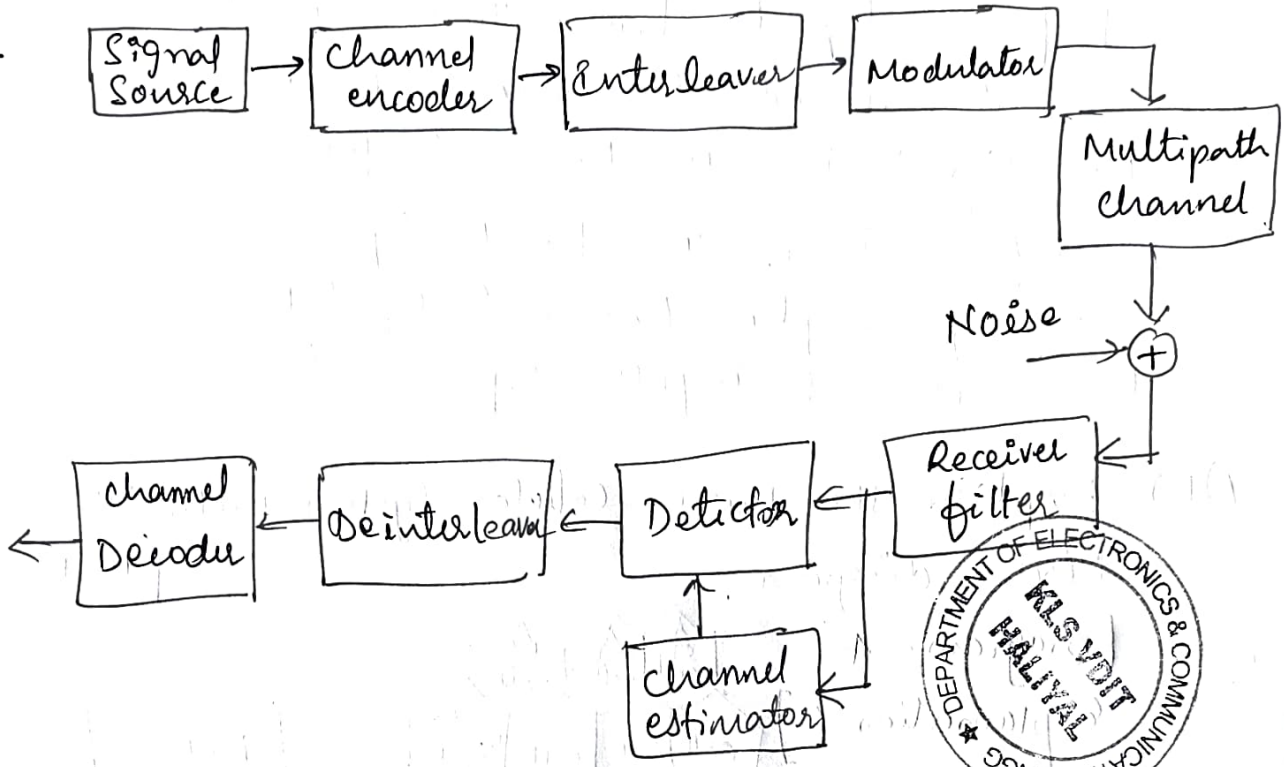


Figure above shows the block diagram of TDMA link.

The signal is first sampled and converted signal which is digitized speech signal. In order to remove redund - ant informations, the digitized speech signal is encoded without compromising the ability of the receiver to prov - ide a high quality reproduction of the speech signal. The channel encoder introduces controlled redundancy bits into speech encoded signal to provide protection against channel noise.

The function of the packetiser is to convert the encod - ed and interleaved sequence of digitized speech data into successive packets. Each packet occupies a significant part of a basic TDMA frame.

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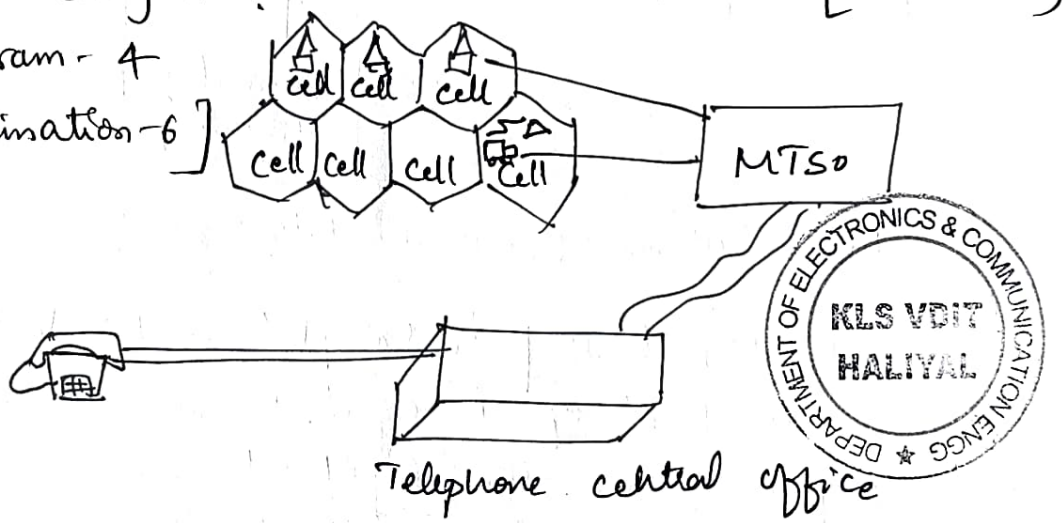
Each frame also includes Synchronisation bits in order to Synchronize the timing operations in the receiver with the corresponding ones in the transmitter.

The receiver side consists of a cascad of several blocks in order to reverse the corresponding operations performed by the transmitter and wireless channel.

The demodulator converts the modulated received RF signal into its baseband form without any loss of informations. The base band processor operates on the resulting complex baseband signal to estimate the un known channel impulse response and channel equalisation

7)b) Explain the basic Cellular System with necessary block diagram [10 Marks]

Ans: [Diagram - 4
Explaination - 6]



The basic cellular radio network covers a number of geographical areas (Cells) connected with landline or wireless telephone communication network deploying PSTN. within the cell, Cellular mobile subscribers can communicate with one another using the cellular network. The cellular network is defined by a set of transceivers located at the centres of each of the cells, and the locations of these radio frequency transceivers are called base stations

A base station serves as an air interface as well as local central control for all mobile subscribers within that cell.

The base station intern communicate directly with the nearest base station. MTSO controls channel assignment, call set up, call processing, and call termination.

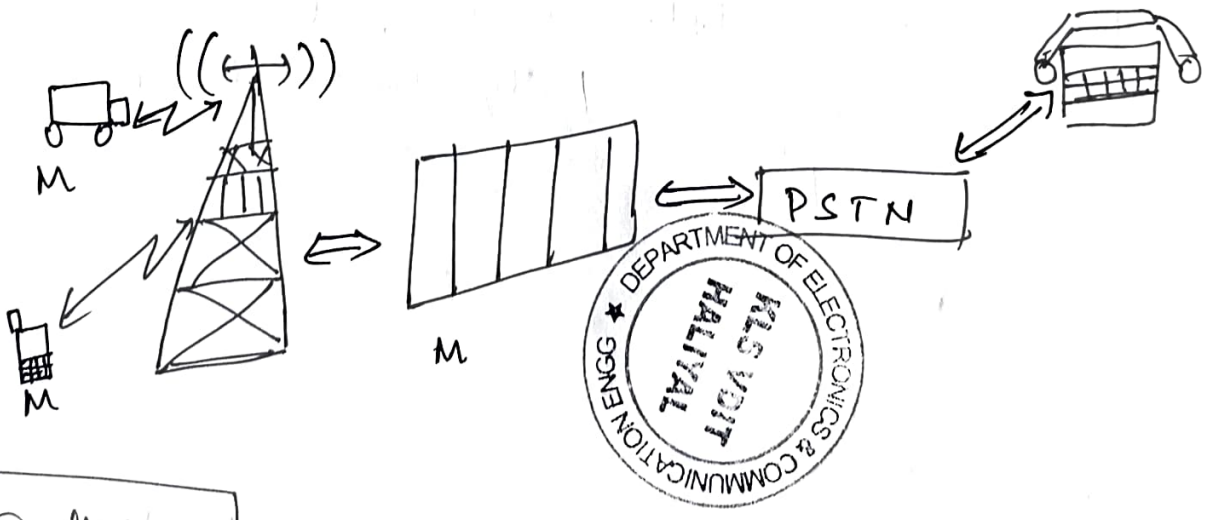
A standard common air interface is defined to establish full duplex communication between the mobile subscribers and the base station in a cellular system. For this purpose, two distinct types of channels are specified in each direction (uplink and downlink)

control channel carries data messages for call initiation and service requests and are continuously monitored by mobile subscribers when they are not engaged in voice call. Each cell site has several radio transceivers called Base Transceiver System (BTS). The cell site's radio equipment is controlled by an on-site cell controller called Base station controller.

8)a) Discuss with neat figure call processing in a cellular system for mobile originated calls.

[Diagram - 6 M, Explanation - 6 M] [12 marks]

Ans:



Prabhu

Steps in Mobile Originated calls:

Step 1: Calls from mobile subscribers to landline can be initiated by entering the landline telephone no into mobile units key pad.

Step 2: The base station receives a call initiation request along with the MIN, ESN and station class mark

Step 3: The MTSO uses either Standard call progress signals or the SS7 signalling protocol n/w to locate a switching paths through the PSTN to the called landline telephone number

Step 4: Using the cite controller, MTSO assigns the calling mobile subscriber an available traffic or voice channel and it is been determined

Step 5: After the cell site controller receives verification that the mobile subscriber has tuned to the selected voice channel and it is been determined that the called landline telephone no is not busy, the mobile subscriber receives an audible call progress tone while the landline telephone called receives a Standard ringing tone.

Step 6: If a suitable switching path is available to the landline telephone number, the call is completed when the landline party answers the incoming call on its telephone.

8) b) List the Advantages of CDMA over TDMA and FDMA [08 Marks]

[8 Advantages — 8M]

Ans: 1) CDMA has greater capacity

2) TDMA and FDMA have a fixed no of slots

3) Frequencies can be reused in all cells in CDMA

4) No hard limit to the number of users

5) Resistance to multipath fading

6) CDMA systems have no channels, but each cell is encoded as a coded sequence across the frequency spectrum

7) Each conversation is modulated, in digital domain

8) Since CDMA offers greater capacity and variable data rates depending on the audio activity, many more users can fit into given frequency spectrum

9) CDMA technology allows lower cell phone power levels (200 mw) since the modulation techniques expect to deal with noise and are well suited to weaker signals

10) The down side to CDMA is the complexity of deciphering and extracting the received signals.

Dalling

Module-5

9) a) What is Handoff in GSM networks? Explain briefly hand off procedure in GSM

[Defn - 3M, Explm → procedure - 7M] [10 Marks]

Ans:→ Handoff is the process of changing the channel (frequency, time, Spreading code) associated with the current connection while a call is in progress.

→ Depending on the nature of occurance of hand off, the hand off procedures can be classified into the following ways:

→ Inter cell hand off
→ Intra cell hand off
→ Hard hand off
→ Soft and softer hand off

1) Inter Cell Hand off

The purpose of this hand off is to maintain the call as the mobile subscriber is moving out of the area covered by present serving cell and entering the area of the new target cell. Sometimes, a mobile call may be initiated in one cellular system controlled by one mobile telephone switching centre.

2) Intra Cell Hand off:

In this hand off, the present serving cell and new target cell are one and the same cell and only the used channel is changed during the handoff. The purpose of the intra cell hand off is to change the channel, which may be interfered or affected by fading.

3) Hard hand off:

The Hard hand off is one in which the channel is present serving cell is released and only then the channel in the new targed cell is engaged. Thus the connection to the present serving cell is broken before the connection to the target cell is made

4) Soft Hand off -

This procedure can establish multiple connections with neighbouring cells. A Soft hand off is the one in which the channel the present serving cell is retained and used for a while in para-llel with the channel in the new adjacent target cell. In this case, the connection to the new adjacent target cell is established before the connection to the present cell is broken, hence hand off is also called make before break hand off.

9) b) Explain the functions of data bases HLR and VLR at MSC in GSM network architecture and also explain how it is helpful in location updatation in GSM networks [10 Marks]

[Functions - 3M, location updation - 7M]

Ans: The two data bases HLR and VLR are used to keep track of current location of an MSC in GSM. Maintainance of two data bases at home and at the visiting location allows a mechanism to support dialing and call routing in a roaming situation where the MS is visiting the coverage area of a different MSC.

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→ Location Management depends on the three states of the mobile user in which it can operate at any time,

→ In the Switched off state, the mobile user is not reachable by the network, and the contents of a packet data protocol are deleted.

→ In Standby State, movement across routing areas is updated to the SGSN but not updated across cells.

→ In Ready State, every movement of the mobile user is indicated to the SGSN.

→ Location management includes location updates, paging and location information dissemination.

→ Location updates are the messages sent by the MS regarding its changing point of access to the fixed network. In order to deliver incoming messages to the MS, the network will have to page the MS in the possible group of cells. If the MS updates its location quite often, it consumes battery power and wastes the resources. If MS updates in frequently, ~~diss~~ a systemwide paging is needed which is also a waste of resources.

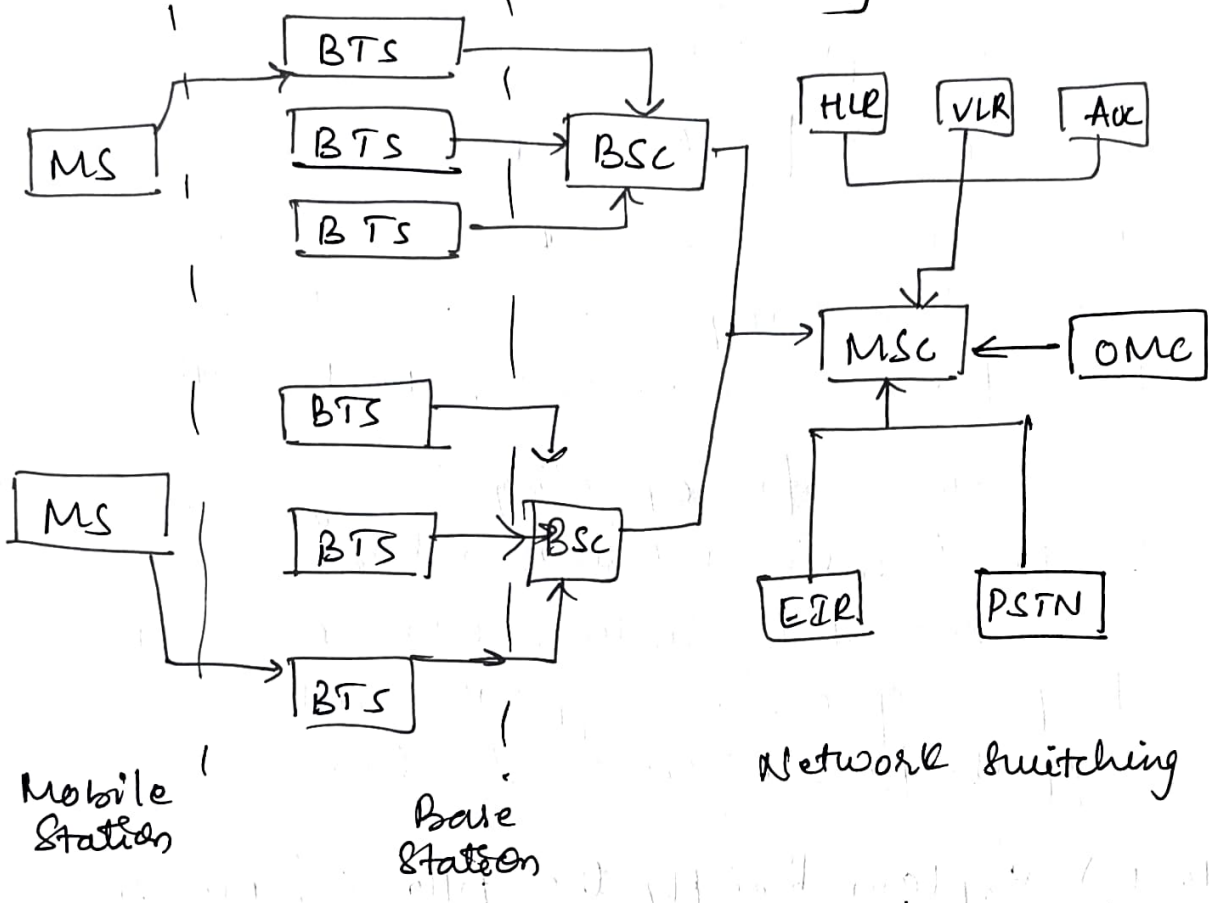
→ In the intra SGSN Routing Area update, the SGSN already has the user profile and packet data protocol context. The HLR need not be updated.

Bhatkar

10) a) Briefly explain the three major subsystems in GSM network architecture with a neat block diagram.

[Block diagram - 5, explanation - 5] [10 Marks]

Ans:



GSM stands for Global System for Mobile comn. It has 4 different sizes of cells called as, Macro, Micro, Pico and umbrella.

It has three Sub Systems

1) BSS → Base Station Subsystem
2) NSS → Network and Switching Subsytem
3) OSS → operating Subsystem

BSS handles traffic and signalling between a mobile phone and the network switching subsystem. BSS having two components BTS and BSC.

BTS Stands for Base transceiver Systems which facilitate wireless comms betn user equipment and a network.

BSC Stands for Base Station controller. BSC has multiple BTS.

NSS Stands for Network and Switching Subsytem. NSS is the core network of GSM. That carried out call and mobility management functions for mobile phone present in network. It has VLR, HLR and EIR.

OSS Stands for operating SubSystem. OSS is a functional entity which is network operator monitor and control the System. OMC is the part of OSS. Purpose of OSS is to offer the customer cost-effective Support for all GSM related maintainance services.

10) b) Explain briefly the following identifier in GSM System.

i) SIM — (4)

ii) Mobile System ISDM with frame format — (3)

iii) Location Area Identity — (4) [10 Marks]

Soln — i) SIM

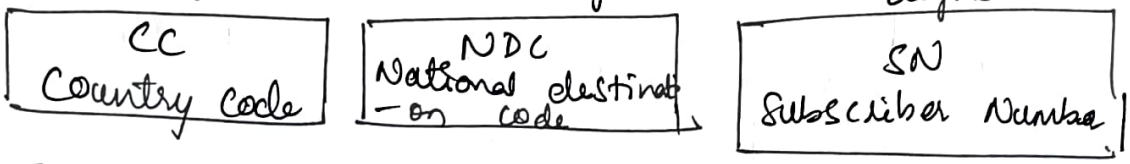
SIM Stands for Subscriber Identity Module

→ A SIM card that utilizes the GSM Network is known as a Subscriber Identity module. The GSM Network which is utilized by the majority of nations worldwide, enables cell phone users to travel with their devices.

Mobile System ISDN with frame format

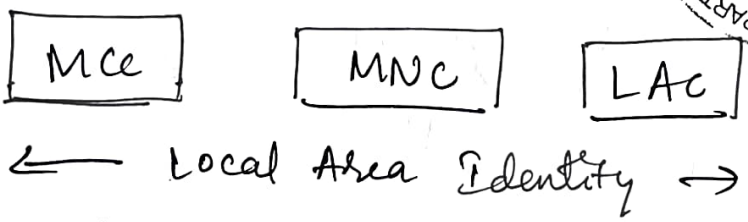
The authentic telephone number of a mobile Station is the mobile Subscriber ISDN Number. Based on the SIM, a mobile Station can have many MSISDNs, as each Subscriber is assigned with a Seperate MSISDN to their SIM respectively.

Frame format



The GSM does not actualy provide an identification of a particular mobile phone, but a particular HLR does it. It is the responsibility of the HLR to contact the mobile phone.

Location Area Identity



Within a PLMN, a location area identifies its own authentic location Area Identity [LAI]

The LAI hierarchy is based on International Standard and Structured in a unique format as given below.

CC → Country code → 3 decimal places

Mobile Network code (MNC) → 2 decimal places

Location area code (LAC) → Maximum 5 decimal places or maximum twice 8 bits coded in hexadecimal

An LA is a cell or a group of cells and is useful when the MS is roaming in a different cell but the same as LA. Since any LA has to be identified as a part of the hierarchical structure, the identifier should contains the country code, the mobile network code and the LA code