INTERNAL 1- ANSWER KEY

1. Define Brewster angle. **[K1]**

Brewster angle is the angle at which no reflection occurs in the origin. Brewster angle **is denoted by θ**B as shown below,

$$sin(\theta_B) = \sqrt{\frac{\epsilon_1}{\epsilon_1 + \epsilon_2}}.$$

2. Recall Soft and Hard handoff in mobile communication **[K1]**

i. Hard hand off – Mobile monitors BS and new cell is allocated to a call with strong signal.

ii. Soft hand off – MS with 2 or more calls at the same time and find which is the strongest signal BS, the MSC automatically transfers the call to that BS.

3. What are the major types of cellular interference**.** **[K1]**

The major types of cellular interferences are as follows
i. CCI – Co-channel interference is the interference between signals from co-channel cells.

ii. ACI – Adjacent channel interference resulting from signals which are adjacent in frequency to the desired signal.

4. What are the techniques used to expand the capacity of cellular system **[K1]**

Cell splitting, Sectoring, Coverage Zone approaches are the techniques used to expand the capacity of cellular system. Cell splitting **–** Cell-splitting is a technique which has the capability to add new smaller cells in specific areas of the system. i.e. divide large cell size into small size. Sectoring **–** use of directional antennas to reduce Co-channel interference. Coverage Zone approaches **–** large central BS is replaced by several low power transmitters on the edge of the cell.

5. Define Doppler shift. **[K1]**

If the receiver is moving towards the source, then the zero crossings of the signal appear faster and the received frequency is higher.The opposite effect occurs if the receiver is moving away from the source. The resulting chance in frequency is known as the Doppler shift (f_D). $F_D = f_r - f_0 = -f_0V/C$
Where f_0 -> transmission frequency f_r -> received frequency

6. Model the Fraunhofer distance for an antenna with maximum dimension of 1m and operating frequency of 900 MHz. If antenna has unity gain, calculate the pathloss. [K3]

Ans :$1.11x10^{-6}$ ms

7. List the various parameters in Link Budget calculation. [K1]

To be able to calculate how far we can go with the equipment we have
To understand why we need high masts for long links
To learn about software that helps to automate the process of planning radio links

8.` Illustrate cell and cluster. [K2]

For a large geographic coverage area, a high powered transmitter therefore has to be used. But a high power radio transmitter causes harm to environment. Mobile communication thus calls for replacing the high power transmitters by low power transmitters by dividing the coverage area into small segments, called cells. Each cell uses a certain number of the available channels and a group of adjacent cells together use all the available channels. Such a group is called a cluster.

9. How will you find Trunking and Grade of Service [K1]

Grade of service is defined as the measure of the ability of a user to access a trunked system during the busiest hour.

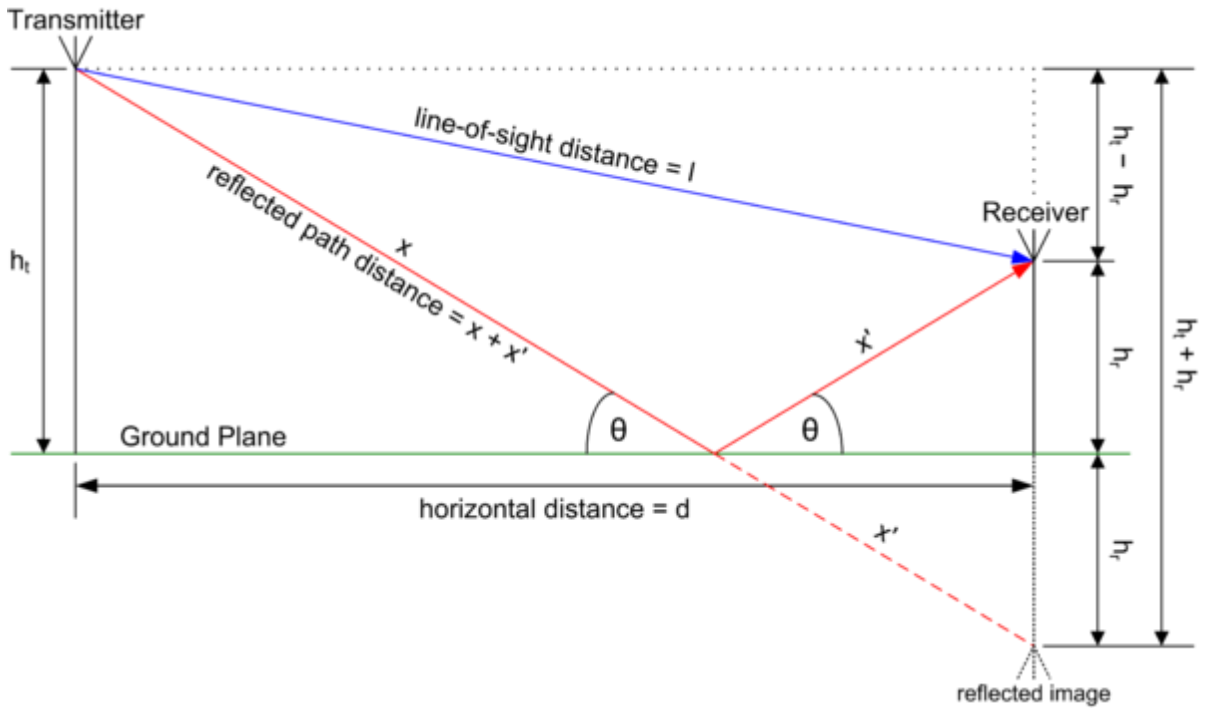
Trunking is a technique used in data communications transmission systems to provide many users with access to a network by sharing multiple lines or frequencies. As the name implies, the system is like a tree with one *trunk* and many branches.

10. Define co-channel reuse ratio. [K1]

In a *cellular* system, there is full duplex *communication*, between a base station and a *mobile*. .... The *ratio* of D/R = √3N is called Q, the co-channel reuse *ratio*.

PART – B **2 × 15 = 30 Marks**

11. a)How would you formulate the expression for electric field path loss and received power for a Two Ray reflection model. [K1] (15)



(OR)

b) Write in detail about outdoor propagation models. [K1] (15)

1 Hata model,
2. Okumura model,
3.Walfish model,

12 a)) Explain in detail about multiple access techniques [K2] (15)

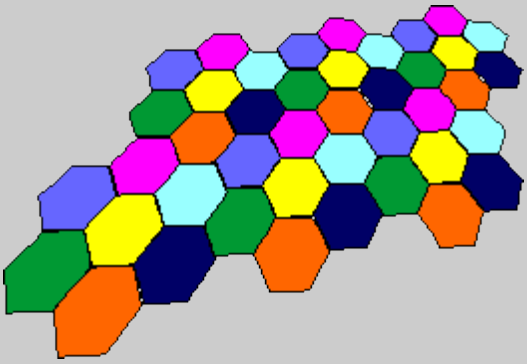
- Frequency Channels [FDMA – Frequency Division Multiple Access] – Frequency band divided into small frequency channels and different channels are allocated to different users – like in FM radio. Multiple users can transmit at the same time but on different frequency channels.

- Time-slot Within Frequency Bands [TDMA – Time Division Multiple Access] – Each user is allowed to transmit only in specified time-slots with a common frequency band. Multiple users can transmit at the same frequency band at different times.
- Distinct Codes [CDMA – Code Division Multiple Access] – Users may transmit at the same time using the same frequency band but using different codes so that we can decode to identify a particular user.

(OR)

b) (i)Write about frequency reuse concept. [K2] (8)

cellular phone networks use cellular frequency reuse. In the cellular reuse concept, frequencies allocated to the service are reused in a regular pattern of areas, called "cells", each covered by one base station. In mobile-telephone nets these cells are usually hexagonal. To ensure that the mutual interference between users remains below a harmful level, adjacent cells use different frequencies. However in cells that are separated further away, frequencies can be reused.



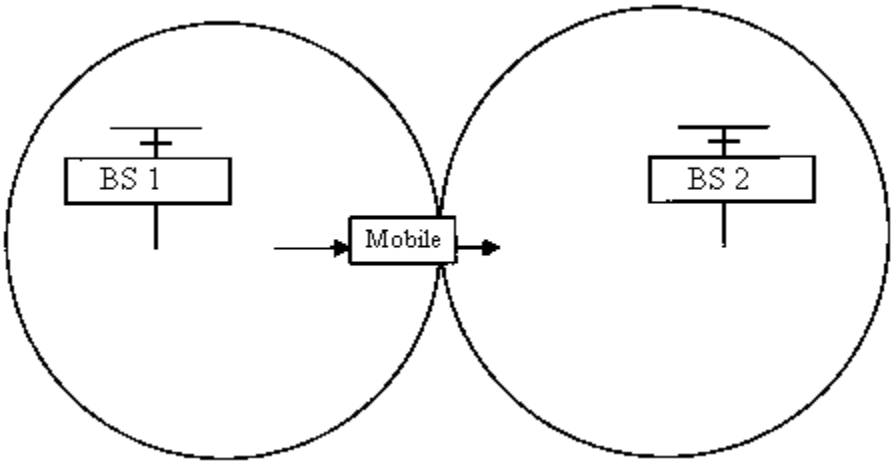
Typical frequency reuse plan for 7 different radio frequencies, based on hexagonal cells. Radio channels are indicated by color. In fact some problems in cellular frequency assignment are solved using map coloring theory.

Particularly in the United States, the term "cell phone" is often used by the public when a wireless phone is meant. The cellular approach was proposed and developed predominantly by the Bell System, in the U.S. in the early 70's, after the regulatory agency FCC has asked for an upgrade of the existing radio telephone service. The FCC had the foresight to require:

- a large subscriber capacity
- efficient use of spectrum resources
- nationwide coverage
- adaptability to traffic density
- telephone service to both vehicle and portable user terminals
- telephony but also other services including closed user groups with voice dispatch operations
- toll quality
- affordability, which could eventually make it a mass-market service

ii) Explain in detail about Handoff strategies. **[K2] (7)**

When a mobile user travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes. Indeed, this ability for transference is a design matter in mobile cellular system design and is call *handoff*.



Two basic types of handoff are defined -- *viz. hard handoff* and *soft handoff.*

With hard handoff, the link to the prior base station is terminated before or as the user is transferred to the new cell's base station. That is to say that the mobile is linked to no more than one base station at a given time. Initiation of the handoff may begin when the signal strength at the mobile received from base station 2 is greater than that of base station 1. The signal strength measures are really signal levels averaged over a chosen amount of time. This averaging is necessary because of the Rayleigh fading nature of the environment in which the cellular network resides. A major problem with this approach to handoff decision is that the received signals of both base stations often fluctuate. When the mobile is between the base stations, the effect is to cause the mobile to wildly switch links with either base station. The base stations bounce the link with the mobile back and forth. Hence the phenomenon is called *ping- ponging.* Besides ping ponging this simple approach allows too many handoffs. [1] It has been shown in early studies that much of the time the previous link was well adequate and that handoffs occurred unnecessarily. A better method is to use the averaged signal levels relative to a threshold and hysteresis margin for handoff decision. Furthermore, the condition should be imposed that the target base station's signal level should be greater than that of the current base station.