ITCS-424
Sem 2- 2019
Homework 1
19/2/20
Time Limit: infinity ? Minutes

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This homework contains 6 pages (including this cover page) and 2 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may *not* use your books, notes, but scientific calculator on this exam.

You are required to show your work on each problem on this exam. The following rules apply:

- **If you use a "fundamental theorem" you must indicate this** and explain why the theorem may be applied.
- **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.
- **Mysterious or unsupported answers will not receive full credit**. A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.
- If you need more space, use the back of the pages; clearly indicate when you have done this.

Problem	Points	Score
1	6	
2	4	
Total:	10	

Do not write in the table to the right.

1. Wireless Channel Link Budget

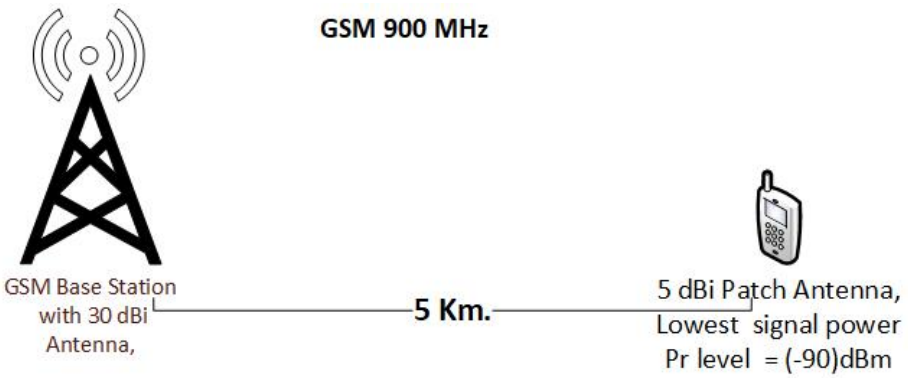

Figure 1: GSM 900MHzTransmittion Link

From given diagram answer following questions, with calculation detail.

(a) (1 point) What is the Friss Model equation?

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2}$$

(b) (1 point) What is the wave length of given system?

$$\lambda = \frac{3\times10^8}{900\times10^6} \rightarrow 0.33\,m$$

(c) (1 point) What is Pr in Watt?

$$-90 = 10\log_{10}(P_r)$$
$$P_r = 10^{-9}\,mWatt$$
$$= 10^{-12}\,Watt$$

(d) (1 point) What is the Gain of antenna at Transmitter ?(Hinkt: without dB)

$$30 = 10 \log(G)$$
$$G = 10^3$$

(e) (1 point) What is the the Gain of antenna at mobile phone ?(Hinkt: without dB? (show calculation)

$$5 = 10 \log(G)$$
$$G = 10^{0.5}$$
$$= \sqrt{10}$$

(f) (1 point) How much power at Transmitter need to apply for 5Km client and maintence least 90dBm at the end of the link ?

$$90 = 10 \log 10 \left(\frac{P_r}{1mW}\right)$$
$$P_r = 10^6 \text{ Watt}$$

$$10^6 = \frac{P_t \times \sqrt{10} \times 10^3 \times 0.33^2}{(4\pi 5000)^2}$$
$$P_t = 1.129 \times 10^{19} \text{ Watt}$$

2. Phased Array Antenna

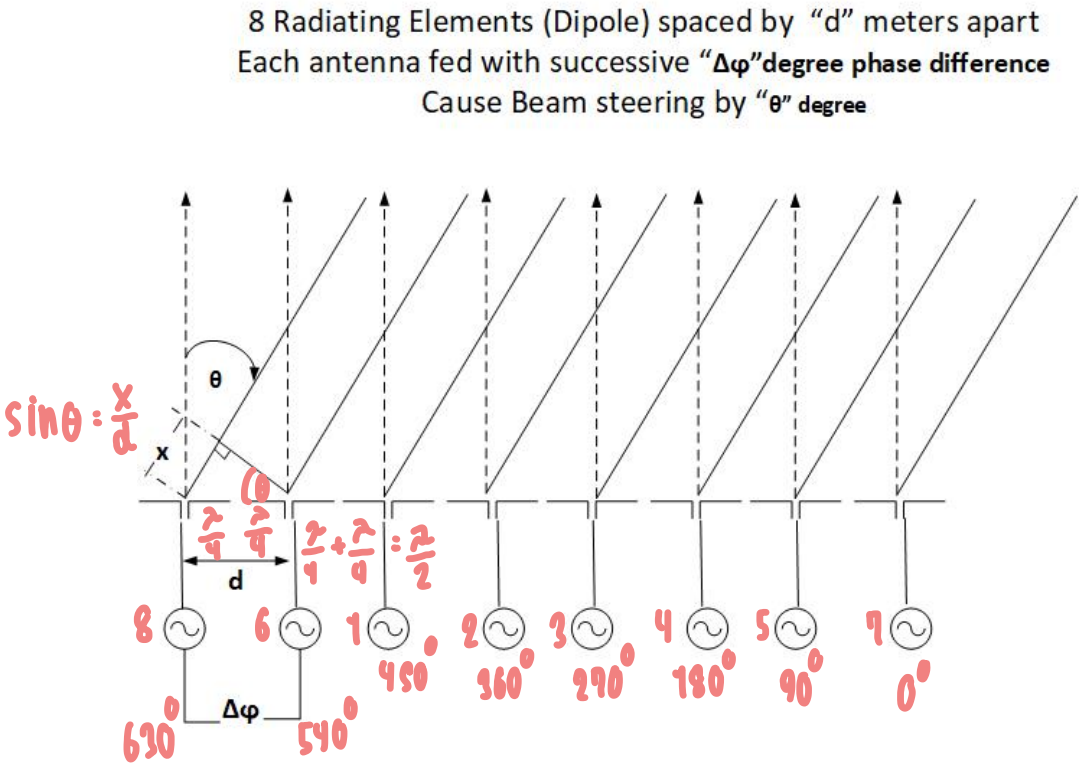

Figure 2: Phased Array Antenna and Beam Steering

Where :-

x : path difference

and assume these radiating elecments will feed by transmitter at same frequenc, 5GHz.

(a) (1 point) What is wavelenght of sending wave?

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{5 \times 10^9} = 0.06\,\text{m}$$

(b) (1 point) If radiating elements placed close together as much as possible, What is distance between two successive elements,d?

$$d = \frac{\lambda}{4} + \frac{\lambda}{4} = \frac{0.06}{2} = 0.03\,\text{m}$$

(c) (1 point) Given followin relationship of phased array antenna and beam streering ,

$$\frac{360\,\text{deg}}{\Delta\varphi} = \frac{\lambda}{x}$$

The phased array antenna will streeing to some Θ deg
depend on your last digit of your student ID.
$1 = 10\,\text{deg}, 2 = 20\,\text{deg} \cdots 6 = 60\,\text{deg}, 7 = -10\,\text{deg}, 8 = -20\,\text{deg}, 9 = -30\,\text{deg}, 0 = -40\,\text{deg}$
What is successive phased shift, $\Delta\varphi$?

from $x = d\sin\theta$

$\Delta\varphi = \dfrac{360^0 d\sin\theta}{\lambda}$

$= \dfrac{360 \times 0.03 \times \sin(30)}{0.06}$

$= 90^0$

(d) (1 point) Verify previous calculation by the simulation in 4NEC for 8 element dipole antenna as mention in the figure(frequency) , feed with 8 successive phased shifte by $\Delta\varphi$
(Hint: 4 Element Phased Array is provided on mycourse).
Show comparision of radiation pattern of zero phase shift and phase shift by previous question below.