

Submit this homework to Ninova for the evaluation of assistant Araş. Gör. M. Barış Kelebek.

Q.1. IONOSPHERE

The max ion/electron production rate and the height at which the maximum occurs can be found using $q_m = \frac{I_0 \cos \chi}{H \exp(1)}$ and $h_m = H \ln(H n_0 \sigma \sec \chi)$.

- Calculate the maximum ion production height over Istanbul under the quiet Sun conditions for $\chi=0^\circ$, $\chi=30^\circ$ and $\chi=70^\circ$ when the scale height is 30 km and atmospheric neutral density is 10^8 [#/cm³] respectively. Assume that the atmosphere is made up by oxygen atoms which has an absorption cross-section of 10^{-12} cm². Assume also a single layer uniform ionosphere.
 - Calculate the maximum ion production rate (q_m) under the conditions given in part (c) using the solar radiation at the top of the Earth's atmosphere as 1600 W/m².
 - Make a **sketch** how maximum ion production rate (q_m) varies with height when $\chi=0^\circ$ and $\chi=70^\circ$ using q_m and h_m you calculated in the previous parts.
 - Using your answer in (c), explain how does q_m vary between equatorial and polar latitudes. Give a comparison.
 - Using your answer in (c), explain how does h_m vary between equatorial and polar latitudes. Give a comparison. What could be the consequences of these differences in h_m on radio propagation over these latitudes? Give a discussion.
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Q.2. RADIO PROPAGATION

- Assume that the ionosphere has only E layer with a maximum electron density of 10^5 #/cm³. What should be the maximum usable frequency (f_{MUF}) of your radio wave in MHz that will be reflected from ionosphere when you sent it at an incidence angle of 60° at a noon time?
 - The skip distance that depends on the radio frequency is given as $D = 2h \sqrt{[(f_{MUF}/f_c)^2 - 1]}$ where h is the height of the ionospheric layer, f_{MUF} is the maximum usable frequency and f_c is the critical frequency. Calculate the maximum distance (skip distance) that you can communicate under ionospheric conditions given in part-a.
 - Assume you are in İstanbul. Can you communicate with a radio station located in Van under the ionospheric conditions in part-a? Which parameter you may want to change (i.e. radio frequency, reflection height/layer, and incidence angle etc.) in order to successfully communicate with Van?
 - Now, assume that a GPS satellite at 20,000 km passes **over head** at the same local time in part (a) and you would like to send a signal to the satellite. Under the same ionospheric density conditions given in part (a), what would be the incidence angle and frequency for a successful communication with the satellite.
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Q.3. Search Question/Brain Storm: Explore what HAARP project is and answer the questions below:

- What is the apparent scientific purpose of HAARP project?
- What are the claims/issues about the HAARP project raised from the public and from the state and private public institutions? i.e. why are they worrying about, especially from the defense and military point of view? Make list of these claims.
- In your opinion, speculate on whether these claims/issues may be true. That is, do you agree in the public's concerns? Can these claims be true in your opinion and why?
- What is the Tesla theory that is related to the HAARP project? What did Tesla intend to do using his theory? i.e. what was his purpose in proposing his theory?

Note: please give only what is asked in this question. Do not give details which are not asked and which are not directly related to the question. The points will be taken off from your grade if you do that.

* Note:

- Homework returned after due date will not be accepted.
- Electronically typed Homework is not accepted. Return your homework in paper work with your handwriting.
- Photocopied or Scanned homework is not accepted.
- Do not use COMPUTER PRINTER OUTPUTS for your homework unless it is with your handwriting.**