**Assigment-4**

1. Consider the two tube lossless vocal tract model as in fig.4 including the radiation and glottal boundary condition. Show that the transfer function of the above two tube can be express as below



**z-1/2**

**z-1/2**



**z-1/2**

**z-1/2**



Fig.-4

1. (a)Reflection coefficient *rk* for the junction of two lossless acoustic tubes of area *Ak* and *Ak+1*can be written as equation (2).



….(2)



Since *Ak* and *Ak+1*are positive show that the value of *rk*will be

(b) Let length of the vocal tract *l=17cm* and the velocity of sound *c=340m/s* find the number of section required to generate *5 kHz* bandwidth voiced signa

3. Bilabial unvoiced fricative sound is produce by constrictions in vocal tract at lips. Consider the vocal tract is model using a lossless uniform tube of length l. The output sound pressure at lips to produce the above fricative sound is *PL(Ω)ejΩt*. Using the wave equation derive the transfer function *H(Ω)*(where *H(Ω)=UL(Ω)/PL(Ω))*

4. A voiced speech sound /u/ is produce by two tube lossless vocal tract model. If the terminations at the glottis and lips are completely lossless. Derive the transfer function of the model in z domain. Draw the digital equivalent circuit diagram of the above voiced speech sound production Model

5. Consider a two tube lossless vocal tract model. Draw the signal flow diagram using reflection coefficient and delay element for the case in which tube cross section and length are as **A1=1 cm2, l1=9 cm and A2 = 7 cm2 and l2= 8 cm**. Include the radiation and glottal boundary condition in the flow diagram. Where velocity of sound **c=340m/s**.