University of Jordan
Elect. Eng. Dept.
First Exam
Reg. No. 0132436

Control Systems 903441
Student Name: [redacted]
Answers should be written in ink

Wendsday 13/7/2016
Mark out of 20
Exam Duration: 50 min

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Q1 a) Classify the following systems as **open loop** or **closed loop** stating the **type of feedback** if the system is closed loop and **appreciable** parameter variations and external disturbances if applicable . Feel free to express your ideas in **Arabic** if you wish.

i) A multi-stage heat seeking missile (صاروخ حراري) .

* Closed loop with a negative feedback (نظام التتبع العزري)
* extend disturbances: Heat Source that the missile follows , outter wether

Parameters Variations like: Speed, (velocity) Stages that being dropped

ii) A football being kicked to hit a certain target.

* open loop * extend disturbances: wind, Way of Shooting (طريقة التسديد) ~~the ...~~ of the pitch type

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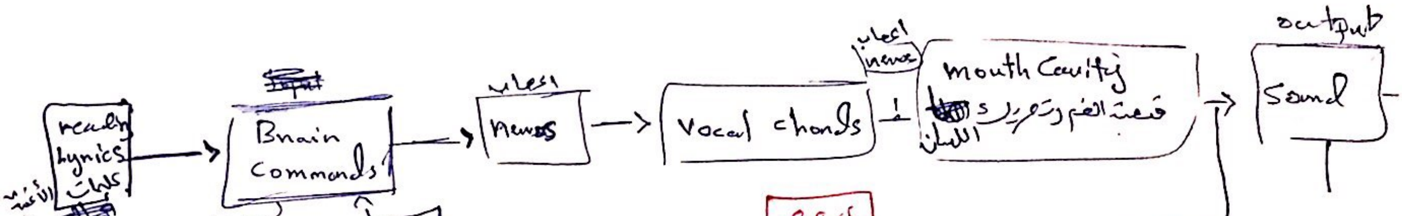
iii) A person riding a bicycle.

* closed loop ((assuming that the driver Eyes open)) , negative feedback
* extend disturbances: ① Ground type (off road, on road) ② Gems oiled

b) Consider the process of producing a human quality sound (صوت مجود). Obtain a **schematic diagram** representing such process with blocks representing **vocal chords, mouth cavity** and any other relevant blocks and signals related to such process. Is such general process representation open or closed loop?



like thinking of a song *~~openloop : no need for Previous Knowledge → Seeing Something~~

closed loop: ((reading on Seeing a Song words (Lyrics)))

2.5

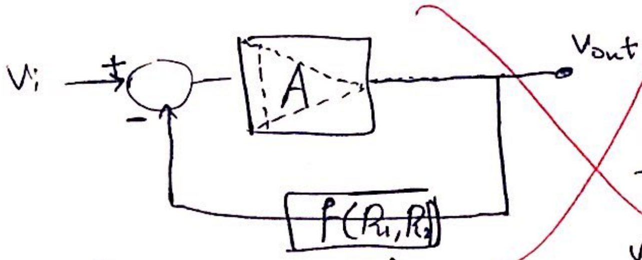
Study the schematic diagram and briefly comment on situations where such process is treated as an open loop process. Feel free to express your ideas in **Arabic** if you wish.

* if he/she is Singing a Song he knows (~~habbit~~) → لا يوجد حاجة لمعرفة مسبقة أو قراءة أو سماعة بيئة خارجية

* أي أنه اذا بدأ الغناء مباشرة بدون أي مساعدة مسبقة أو قراءة مسبقة فلا يوجد حاجة لل feedback فقط أوامر عقلية مخزنة

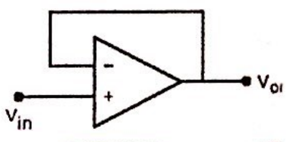
c) Consider the op-amp circuit shown. Use the practical op-amp model involving both R_i , and R_o to obtain a block diagram **involving feedback** with V_{out} as output, and V_{in} as set value

0



$V_o = A v_i$

$V_o = \frac{-R_2}{R_1}$



Q2) a) Derive an expression for S_k^{MN} where M, and N are both functions of k. Hence or otherwise, obtain $S_k^{M/N}$. Use your findings, or otherwise to obtain the sensitivity of S_k^G as $k \to \infty$ when $G = \frac{k}{k^2+1}$. Is G sensitive to variations in k? why?

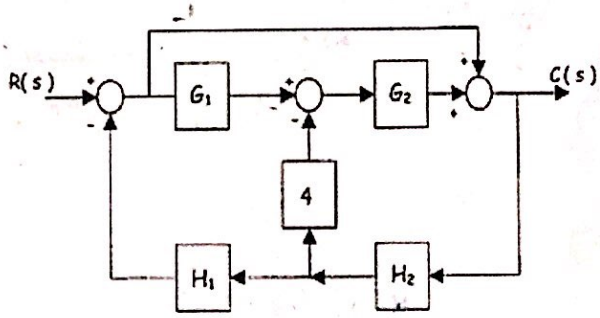
almost $S_k^{M/N} = 1$ & that only depends on k

$$S_k^G = \lim_{k \to \infty} \frac{k^2 - 3k}{k^2+1} = \frac{\infty}{\infty}$$

G is very Sensitive to Variations in k

because when it goes to ∞ it gets high Values.

b) Using block diagram reduction techniques to obtain $\frac{C(s)}{R(s)}$



R(s) G_1 $1/G_2$ $\frac{G_1 G_2 H_1 H_2}{1 + G_1 G_2 H_1 H_2}$ $\frac{4 G_2 H_2}{1 + G_2 H_2}$ C(s)