

Use of internet resources via smart phones or laptops is unfortunately illegal during this exam. Please do NOT force me to penalize any of you. Use the precious organ inside your skull to analyze problems ....

## BYM 501E FUNDAMENTALS OF BIOMEDICAL ENGINEERING (15414)

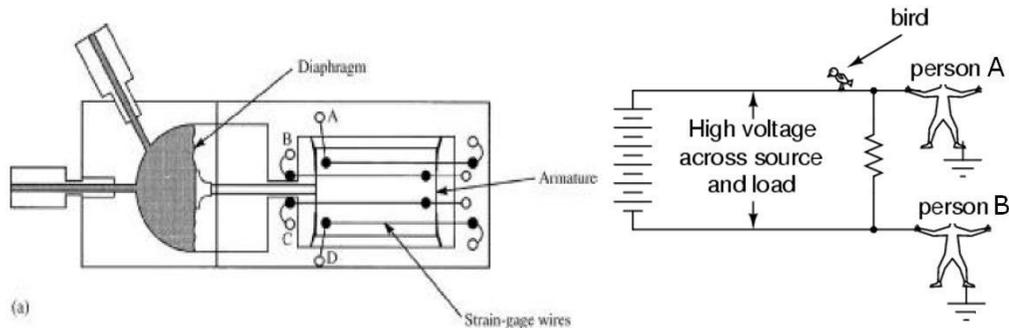
Inci ÇILESIZ

Mid-Term Examination ✍ 21 November 2016 ⌚ 14.00-16.00

1. Define, compare and contrast the following terms in terms of biomedical measurements and instrumentation operation:
  - a. invasive / non-invasive
  - b. direct / indirect
  - c. real-time / delayed-time
  - d. rise time / sampling rate
  - e. damping / bandwidth

and provide examples for each set of terms. (3x5 points)

2. What instruments (signal generator, multimeter, oscilloscope, etc.) would you use and how would you design measurements to measure dynamic properties of a biomedical measurement system? Which properties would you measure? Why and how? (10 points)



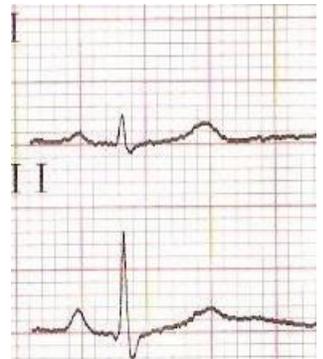
3. Above left you see a strain-gauge pressure sensor. (8 points)
  - a. State whether it is bonded or un-bonded type, why?
  - b. How is the pressure signal transduced into an electrical signal?

4. Study the figure shown above right. What do you think will happen to person (a) A, (b) B, and the bird; WHY? (12 points)

5. Show mathematically, that by using the augmented leads, detected bioelectric signal amplitude is increased 50% as compared to unipolar frontal plane leads without effecting the direction of the lead vector? (10 points)

6. Explain within 3 sentences maximum the function of driven-right-leg circuit. (5 points)

7. On the right you see my EKG signal from leads I and II. Try to guess and sketch how my cardiac vector will look like during one cardiac cycle. (20 points)



8. When studying excitable cells: (3x4 points)

- a. What are the main factors involved in the movement of ions across the cell membrane at steady state?
- b. How do membrane characteristics change during an action potential?
- c. Why is it necessary for the ventricular action potential to have a relatively long refractory period?

9. What are the main interfering or modifying inputs to equipment in a hospital environment? How can you minimize them? (8 points)

**GOOD LUCK**