Microelectromechanical Systems for Mechanical Engineering Applications
(마이크로기전시스템의 기계공학 응용)

기출문제 예시 (기말고사에서는 아래 제시한 문제 개수보다 조금 많습니다)

1. There are numerous sensing/actuation combinations in (Bio)MEMS devices. Fill in the blanks (A to F) in the following table and briefly explain the operation scheme by using an example. (5 pts each)

Output / Input	Mechanical	Thermal	Electrical
Mechanical	A		D
Thermal	B		E
Electrical	C	F	

- MEMS/BioMEMS의 핵심인 sensing/actuation 방법 및 원리를 묻는 문제

2. Briefly explain the following terms. (4 pts each)
   (1) Gauge factor
   (2) Figure of merit (Z) in thermoelectric device
   (3) Lab-on-a-chip
   (4) Anodic bonding
   (5) Hermetic/non-hermetic sealing

- 간단한 용어나 개념을 묻는 문제

3. We learned that polydimethylsiloxane (PDMS) is frequently used in BioMEMS devices in various ways. (10 pts)
   (1) Why is silicon not so attractive for BioMEMS devices? (3 pts)
   (2) What are the advantages and disadvantages of PDMS based devices? (3 pts)

(3) Explain how to attach PDMS channel to glass or to another PDMS channel. (4 pts)

- BioMEMS 공정에서 많이 나타나는 PDMS 공정에 대한 문제

4. In deriving coefficient of performance (COP) in thermoelectric devices, we have

$$q_c = (S_2 - S_1)IT_c - K\Delta T - 0.5I^2R, \quad w = (S_2 - S_1)I\Delta T + I^2R$$

where q_c is the total heat removed from the source and w is the electrical power. The variables were defined in the class. (S: Seebeck coefficient, K: Thermal conductance of the two legs, R: Electrical resistance of the two legs, I: Current density, etc.) (15 pts)

(1) What is the maximum value of COP (ϕ_{max}) in terms of figure of merit (Z) and the related temperatures? (10 pts)

(2) Based on this result, how to increase COP using material properties? What is the fundamental limitation? (5 pts)

- MEMS example에서 Thermoelectric device의 계산 문제

5. (5 pts each)

(1) Suggest two ways to reduce the out-of-focus problem in fluorescent microscopy.

(2) Mention a couple of issues for protein chip and suggest ways to solve the problem.

- BioMEMS에서 detection 및 device example에 대한 문제