The following ten questions are qualitative and examine your basic knowledge of BioMEMS, they all have short answers. If needed, you can draw a schematic to explain your answers.

1) Which of the following wet silicon etchants have the worst p++ etch stop selectivity, EDP, KOH, or TMAH? (5 points)

2) In Texas Instrument micro-mirror array, the mirrors are made of ???? and ???? is used as the sacrificial layer? (5 points)

3) Name two advantages of silicon wet etch as compared to Deep Reactive Ion Etch (DRIE). (5 points)

4) Name two methods used for thin metal film deposition and identify one that has a better step coverage. (5 points)

5) What is the main material selection consideration for anodic bonding between two substrates? (5 points)

6) Name two methods used to reduce stiction when releasing surface micromachined structures? (5 points)
7) Name two methods used to create hemetically sealed microcavities in surface micromachined devices and explain how this is achieved? (5 points)

8) What is the difference between a chemical sensor and a biosensor? (5 points)

9) Ring and beam structure (below) is used to measure intrinsic stress in thin films, explain the reason behind its application and how it works? (5 points)
10) Name two advantages of bossed membrane (below) as compared to standard flat one when used for making pressure sensors? *(5 points)*
A) Silicon on Insulator (SOI) wafers have become very popular for fabricating MEMS devices, these SOIs are different than the ones used for electronics and they have much thicker device and oxide layers, propose a fabrication process to make the SOI wafer shown below considering practical limitations associated with growing thick oxide layers (drawing is not to the scale) (10 Points)

<table>
<thead>
<tr>
<th>Silicon device layer 20 μm thick</th>
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<tr>
<td>Buried oxide layer 5 μm thick</td>
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<tr>
<td>Silicon substrate 500 μm thick</td>
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B) Which one of the four configuration for a piezoresistive cantilever sensor has the best sensitivity, justify your answer (10 Points)
C) Figure below shows the placement of 4 resistors on a silicon membrane used as a pressure sensor; explain why they are located where they are and why in that particular direction. (10 points)

D) Wheatstone bridge is a common circuit used in resistive sensors; they can be single arm, half, or full bridge. Draw all three configurations, find their sensitivity $V_o/V_{in}$, and explain the advantages and disadvantages of each. Assume it's a DC bridge and $V_{in}$ is the excitation supply voltage. (20 points)

E) Piezoelectric actuators can be either uni-morph or bimorph, draw a schematic for each one, mark the polarization direction of each layer and explain how they work, what is the advantage and disadvantage of each? (10 points)