Learning Microsystems Through Problem Solving: Procedure Checklist – Procedure I

✓	Task	Comments
	1. **Select a problem to solve.**	**Refer to Learning Microsystems Through Problem Solving Challenge Problems**
	2. **Write a problem statement.**	*e.g.,* **A** *MEMS designed to detect the H1N1 virus in the field or at home would require a sensing component that would detect ONLY the H1N1 virus while ignoring other analytes in the sample.*
	3. **List the variables associated with this problem.**	**What will the device sense? What will change?** *(e.g., The H1N1 sensing component would "sense" the presence of the H1N1 virus in a small amount of saliva from a mouth swab placed on an "application point "on the MEMS device. The sensing component would react to the presence of the virus by indicating a change in one or more of the component's operating parameters such as its position, resistance, frequency, temperature, etc.)*
	4. **List the criteria to which you will base your design.**	**Size, versatility, transducing capability, electronic interface, etc.** *(e.g., The H1N1 MEMS must be portable, small enough to be easily integrated into a handheld unit, sensing element will be disposable, self-powered, easy to use.)*
	5. **What assumptions did you make when determining your variables and criteria?**	*e.g., It was assumed that (a) enough of the H1N1 virus could be found in a small sample such as the saliva from a swab (b) a probe coating could be develop by our bio-chemical engineers to detect and isolate the H1N1 virus, (c) a micro battery will be used to power the device.*
	6. **Choose the MEMS component that you will design and build.**	**Refer to the component description cards provided.** *(e.g., It was determined that a Surface Acoustic Wave (SAW) micro device could be used to identify the H1N1 virus. A SAW will detect a shift in the resonance frequency of an acoustical wave due to mass loading. The shift is created when the surface wave crosses over a variable surface, in this cause a coated gold film that detects and captures the H1N1 virus.)*
	7. **State the inputs (variable and fixed) and outputs of the MEMS component.**	**Inputs and outputs depend on the type of component. Inputs/outputs may be different for a transducer vs. an actuator.** *(e.g., Inputs: The variable input (sample) to the SAW component is a liquid solution containing the swabbed saliva. A fixed input is an acoustic wave generated by an input transducer. Outputs: A transducing receiver that can measure the frequency shift of the acoustical wave caused by the sample H1N1 viruses captured on the functionalized surface.)*
	8. **Create your design:** a. **List the parts of your MEMS component** b. **Make a rough drawing of the component (show inputs/outputs)**	*e.g., The parts of the SAW component are the (a) input and output transducers that generate and receive the acoustical wave, (b) a probe coating that captures the analytes (i.e., the H1N1 virus) from the sample.*
	9. **Identify the component layers.** a. **Create a mask set: one mask for each layer (optional)**	*e.g., SAW component – substrate, piezoelectric material, transducer electrodes and sensor plate, probe coating layer, and microfluidic channel cap.* **See the procedure for a list and description of layers used for MEMS.**
	10. **Build a model of your device**	**Use the supplies provided.** Using the information that you have developed, build a model of your MEMS component. You may use any and all of the materials in the supply box.

Learning Microsystems Through Problem Solving : Procedure Checklist – Procedure II

✓	Task	Comments
	11. <u>Create a process flow chart</u> to fabricate your device	**Use the process cards in your supply box to construct your flowchart.** See procedure for example related to the SAW component.
	12. <u>Describe the manufacturing process(es)</u> required for creating the device	**Refer to the process description cards provided.**
	13. Describe the <u>packaging</u> for the MEMS.	**How will this MEMS interface with the user? How will the product be used?** *(e.g., The H1N1 portable detection unit will be hermetically sealed. The test for the virus, the user will removed a seal from the "input", then roll swab on the input pad. After a designated amount of time, the output will indicate Red (virus possibly present – see a doctor) / Green (no virus detected).*
	14. Describe the <u>testing</u> requirements for your MEMS. (optional)	**What tests are required to test the effectiveness of your MEMS?** *(e.g., Because this is a biomedical device, it would be required to follow the FDA regulations for biomedical approval. This approval entails several stages of testing from animal testing, to a small group of human subjects to larger groups of human subjects. For more information on this, please see the SCME <u>BioMEMS Regulations Learning Module</u>.)*
	15. Describe the <u>advantages and disadvantages</u> of your MEMS compared to current method(s). (optional)	**What are the advantages/disadvantages of your MEMS compared to current method(s)? (If applicable) What is the benefit of using a MEMS to solve this problem?** *(e.g., According to the Center for Disease Control and Prevention, testing for H1N1 is determined using a nasopharyngeal swab or aspirate, nasal swab plus a throat swab or nasal wash, or tracheal aspirate confirmed with a viral culture or real-time polymerase chain reaction (RT-PCR) procedure. In both cases this is a timely process, during which time any patient who actually has the virus could become seriously ill. The advantage of this home test for H1N1 is to provide a quick diagnosis so that treatment can be started ASAP, especially is H1N1 flu symptoms co-exist. The disadvantage is that false positives could results due to the sample being inadequate, a faulty device, or inadequate application of saliva.)*
	16. Present Your Design	Be prepared to discuss your component and defend its use in a MEMS that can solve the problem stated in Procedure I: Step 2.