

## **University of Arkansas Microelectronics-Photonics Graduate Program**

### **PhD Candidacy Exam – Biological Topic – March 19, 2010**

#### **PROBLEM TO BE SOLVED**

Rising obesity rates nationwide are contributing to growing incidence of diabetes that contributes substantially to the cost overburden of healthcare. Your company's commercially successful noninvasive glucose monitoring provides a convenient, non-invasive, real-time measure of blood glucose levels that minimizes patient discomfort and greatly assists physicians and patients in control of this potentially debilitating illness.

Your CEO is interested in expanding your company's non-invasive product line by harnessing recent advances in materials, spectroscopy, and data-analysis techniques. She wishes to develop other non-invasive, cost-effective, low-power, highly-sensitive technologies to analyze blood chemistry in ways that assist the prevention, detection, or treatment of genetic disorders such as cancer, cardiovascular disease, and auto-immune disorders. Circulating bio-markers for these illnesses are often proteins, nucleic acids, or carbohydrates present in dilute concentrations, whose configurations can be altered relative to a healthy state. Possible product applications range from rapid reaction monitoring in hospital or emergency room situations to remote, long-term surveillance in out-of-office settings.

Your task as CTO is to apply your background in nano-micro materials, devices and processing to develop technologies that address this area of need. You are expected to develop a cost-competitive, practical, improved product (or products) that provide noninvasive assessment of blood chemistry without a needle stick to address a critical health care need. It has been noted by your company's field engineers that large markets exist for new products that prevent, diagnose, or provide therapy to populations with chronic, disabling, or life-threatening illnesses, and you are encouraged to include this information in your development.

#### **YOUR DELIVERABLE**

Your task is to write an internal proposal for your corporate officers describing your approach to this issue, with clear specifics on such things as what specific aspect(s) of this problem you feel your company should address and what market(s) your proposed product(s) should target. The proposal should include the following:

- Executive summary (one page)
- Risk assessment roadmap form (one page)
- Full proposal (15 pages maximum)
- Appendix A: Bibliography (no page limit)
- Appendix B: Ranked list of intellectual property documents examined (no page limit)

Be sure you address at least all of the following:

**Current Science and Technologies** - What is already being done in this area by other researchers, companies and governmental institutions? The current state-of-the-art for both the science and the implementation should be described, making use of diverse resources such as science literature, journals, industry publications, conference proceedings, the internet, patents or other sources of existing public knowledge. **Be sure to cite all references that you use and to quote any word-for-word transfer to your report.**

**Your Design Approach** – What is the basis for your chosen design approach to the problem? Address why your product is better than the existing product solutions and what product attribute(s) allow suitable market penetration for profitability. Be sure to address both the scientific and engineering issues of the question.

**Testing and Qualification** - Describe a set of tests and demonstrations that you will use to demonstrate the effectiveness of your approach and to give confidence that the implementation of the solution will launch successfully.

**Cost Analysis** – Detail the cost and market issues that will impact the pricing strategy of the solution you have proposed. Because the CEO is concerned with potential IP leakage if a device is built outside of the company, subcontracting of the manufacturing or assembly of any proprietary component outside of the company is discouraged.

For instance, your analysis could include such things as the major cost items that would impact the implementation, which elements of your implementation solution would be handled in-house versus externally-sourced, major risk elements that could drive up costs if the primary path item fails, costs of IP licensing needed, etc. For anything you address, be sure to include not just the “what”, but also the justification and/or reasoning behind your decisions. Remember, the marketing team needs a good manufacturing cost estimate for the total system as the product reaches mature product stage in order to determine potential market size.

**Intellectual Property** - In Appendix B list in rank order of importance all commercial, academic, and governmental IP sources that were consulted while formulating the answer, including key important reference data. For instance, if the IP source is a patent, include the patent number; title; inventor name; and assignee name. The top three items in your ranked list should be discussed within the 15-page document, making comparisons of strengths and weaknesses of these approaches relative to your own. Include your recommendations on how these IP threats should be handled.

**Most importantly** - this is just a minimum list of issues you might consider. There may be many more. The point is that your report ***should contain the evidence*** needed to make an effective and compelling case to your CEO in order to insure that she makes the right decision.

**Hint** - Your report should read like a story – one logical step followed by another. This will help you stay focused! Re-read along the way to be sure that you have one logical step followed by another.