

University of Saskatchewan
College of Engineering
EE 328.3
Engineering Design II
Final Examination

April 2000

Instructors: R.E. Gander and J.G. Huff
Time: 3 hrs.
Notes: Reference material allowed.

MARKS

- 10 1. Computerized circuit simulation is an extremely valuable tool in the design of electronic circuits. It is however, unlikely that a laboratory prototype would perform exactly the same as its simulation. Identify, in point form, as many reasons as you can for this difference.
- 15 2. The manufacturer of gasoline powered outboard motors for recreational water craft evaluates these motors on a specially built TEST BOAT. This manufacturer requires a speedometer for this TEST BOAT. Discuss 3 concepts that could be used as the speed sensor. Provide enough detail to convince a fellow Engineer that your ideas are workable.
- 20 3. A transducer company has just developed a new CAPACITIVE sensor. The capacitance changes as the measured variable changes. This company would like to show how the change in capacitance(C) could be converted to a change in frequency(f) or a change in voltage(V). Describe two general circuit concepts - one to convert a change in C to a change in V and the second to convert a change in C to a change in f. Schematic diagrams should be used to provide compelling evidence that the techniques will work.

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- 20 4. A potential customer would like your company to design a vibration sensor for electric motors. Prepare a list of questions that you would take to your first meeting with the customer. It is expected that you could generate a Statement of Work from these questions and their answers.
- 20 5. Prepare a "Requirements Specification" based on the attached "Statement of Work" for an "Electronic Starters Pistol". (See Attached). Also identify any topics which will require further investigation or another meeting with the customer.

..... Attachment follows.

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Attachment to Final Examination

Electronic Starter's Pistol

Statement of Work

An Electronic Starter's Pistol (ESP) is to be designed and prototyped to replace existing starter's pistols used in timed sporting events. The ESP will have outputs equivalent to traditional starter's pistols with improved reliability and lower operating costs. This portable handheld device may be triggered by a mitten hand, and will emit both an audio signal to start the athletes and an optical signal for event timers to start timing from.

The input to the ESP will be a hand triggered pressure with snap-back action as feedback to indicate firing has occurred. The outputs will be a unique optical signal visible diagonally across a football field and a sharp sound audible at twenty meters. The optical signal must be distinguishable from a camera flash, and visible against the sky in daylight. The audio signal must be adjustable for indoor and outdoor levels. It must be sharp enough to be distinguishable from crowd noise.

The ESP will be a light handheld device. A user must be able to hold it comfortably above their head for three minutes. It must be packaged according to NEMA specifications for a damp environment and operational within the automotive temperature range.

- Twenty firings must be executed before replacement of batteries or other components.
- The misfire rate must be equal to or less than one per hundred.
- The delay between the trigger, the optical signal, and the sound will be much less than the human reaction time (approximately 1/5 of a second)
- Regeneration time for the sound signal must be one second or less.
- The regeneration time for the optical signal will be thirty seconds or less.

The manufactured cost of the starter will be ten percent of current starter pistol retail prices. The cost of producing the prototype will be in the range of one hundred dollars, based on single parts purchase prices.