EE 4BD4 Midterm 2015
October 28, 6:30 – 8:00 pm

1. You are asked to design a portable instrument to continuously measure the skin temperature of a subject who is working in a very cold environment. The instrument will be carried in a pocket. What temperature sensor would you use and why? What are its operating principles and characteristics? Briefly sketch the instrumentation required to present the temperature signal to a recording microcontroller. What sources of noise (error) would you have to consider?
(10 marks)

2. What are the assumptions made for the Einthoven triangle concept of measuring the electrical heart activity? How valid is each assumption in your estimation. Consider, the Lead I signal. How does its amplitude relate to the heart dipole amplitude and direction? How are the features of the Lead I signal related to the electrical and mechanical events of the cardiac cycle?
(10 marks)

3. It is well known that when the transmembrane potential of an excitable membrane is raised a certain amount from resting, the membrane generates an action potential that can travel down the axon to excite either other neurons or muscle fibers (shown below). A physiologist would like to know the transmembrane threshold potential for a particular unmyelinated axon being studied in vitro (removed from the body and placed in a holder containing an ion-rich solution – shown below). The action potential duration is about 0.5 ms and amplitude from resting greater than 100 millivolts. Design a system including all transducers and signal processing hardware/software to allow him/her to do this. Use block schematics with specifications and where possible detailed descriptions, such as electronic circuits. As well include a brief description of how your system will work. **(15 marks)**

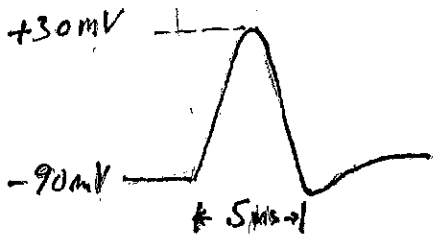

Fig **1** Unmyelinated Nerve Action Potential

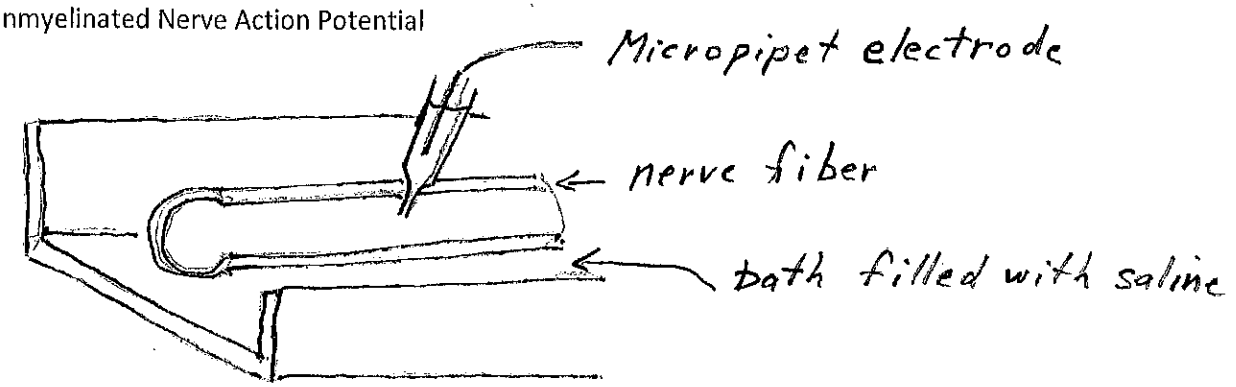

Fig 2 Measurement of Transmembrane Nerve AP

The End