NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH 2203 – INSTRUMENTATION PHYSICS

BSc. HONOURS PART II: MAY 2005 DURATION: 3 HOURS

ANSWER ALL QUESTIONS FROM SECTION A AND ANY 3 QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS.

SECTION A

1 (a) What is a
(i) Signal processing element and a
(ii) Data presentation element.
Give examples in each case. [4]

(b) Define and distinguish the terms *span* and *range*. [4]

(c) Explain two types of environmental inputs that affect the output of a measurement system. [4]

(d) What is a strain gauge? Draw a clearly labelled diagram that shows how a strain gauge can be used to produce a voltage signal when a force is applied to it. [4]

(e) With the aid of clearly labelled diagrams explain two thermocouple junction configurations. What are the advantages and disadvantages of each configuration? [4]

(f) What is an IC sensor? What are the advantages of using an IC sensor to measure temperature in the range 0 – 100 ^{o}C over an RTD and a thermocouple? [4]

(g) What do you understand by
(i) Mass flow rate and
(ii) Volume flow rate.
Include relevant equations where possible. [4]

(h) An electromagnetic flow meter is used to measure the volume flow rate of conducting fluid in a circular pipe of radius 0.10 m. Calculate the average velocity of the fluid if the magnetic field is 0.15T and the voltage appearing across the measurement electrodes is 0.8 V. [4]

(i) With the aid of a well-labelled diagram explain how a semiconductor detector is used to measure radiation. [4]

(j) The 4 – 20 mA current loop is a popular medium for industrial signal transmission. Suggest two reasons for its popularity. Explain how it is possible for a two-wire current loop system to utilize the signal wire pair to supply power to sensors.