MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF EDUCATION (SCIENCE)

SPH 442: INSTRUMENTATION SYSTEMS

DATE: 30/6/2017 **TIME: 2 Hours**

INSTRUCTION:

Answer Question **ONE** in **section A** and Any Other **TWO** Questions in **section B.**

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

a) i) What is electronic instrumentation? (1 mark)

ii) State the three fundamental elements of a measurement system (3 marks)

iii) By use of an example, distinguish between sensor and transducer (3 marks)

b) Give the measurable physical quantities in the following energy types: (4 marks)

i) Mechanical
ii) Thermal
iii) Electrical
iv) Magnetic

c) Discuss two characteristics of electronic instruments compared to mechanical or electrical ones (2 marks)

d) Define the following terms as commonly used in instrumentation systems (3 marks)

i. Reliability

ii. Accuracy

iii. Precision

e) State any two examples of transducers (2 marks)

f) i) List two types of Analogue to Digital converters (2 marks)

ii) Outline two types of Digital to Analogue converters (2 marks)

g) i) Define signal conditioning (1 marks)

ii) State any three characteristics of typical analog systems (3 marks)

h) State four useful applications of Micro-Electro-Mechanical Systems (MEMS) (4 marks)

QUESTION TWO (20 MARKS)

a) State ideal characteristics of an ideal operational amplifier (5 marks)

b) By use of an example, explain any three sources of errors in instruments. How are they eliminated? (7 marks)

c) Light Dependent Resistor, LDR, are used in street lamps, camera light meters, alarm clock, burglar alarm circuits, light intensity meters, and counting packages moving on a conveyor belt. Explain how LDR are used in: (8 marks)

(i) Street lamps,
(ii) Camera
(iii) Light meters
(iv) Counting packages moving on a conveyor belt

QUESTION THREE (20 MARKS)

a) State any three advantages of the fiber optics sensor. (3 marks)

b) With illustrations, discuss any three types of proximity sensors (6 marks)

c) Use a diagram to explain the principle of operation of a thermistor as a transducer for temperature (5 marks)

d) Depending upon function, infrared sensors are grouped as thermal and quantum. What are the differences between these two types? (6 marks)

QUESTION FOUR (20 MARKS)

a) Explain the following characteristics (4 marks)

i) Sensitivity
ii) Resolution
iii) Hysteresis
iv) Wear and aging

b) Think of an Oscilloscope as an electronic instrument. Sketch its corresponding measurement systems. Show physical quantities, forms of energies components receive/produce, and major parts (8 marks)

c) State four Digital Analog conversion devices. Discuss the significance of converting analog physical quantities to digital signals (8 marks)

QUESTION FIVE (20 MARKS)

a) Rotary encoders are divided into two, namely incremental and absolute. Discuss, with the aid of diagrams, these encoders in terms of their:

   i) Differences (8 marks)

   ii) Applications (8 marks)

b) Discuss five applications robotic instrumentation (4 marks)