



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SPH 442: INSTRUMENTATION SYSTEMS

DATE: 29/4/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS TO CANDIDATES

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

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) By use of an example, distinguish between sensor and transducer (4 marks)
- b) Define the following terms as commonly used in instrumentation systems (3 marks)
 - i. Reliability
 - ii. Accuracy
 - iii. Precision
- c) Give the measurable physical quantities in the following energy types: (4 marks)
 - i. Mechanical
 - ii. Thermal
 - iii. Electrical
 - iv. Magnetic
- d) State any four advantages of digital multimeters in measurement (4 marks)
- e) How will one know that an instrument is accurate? (2 marks)
- f) Outline the major components of a measurement system? (4 marks)

- g) Every measurement that is made is subject to a number of errors. By use of an example, explain any three sources of errors in instruments. How are they eliminated? (6 marks)
- h) State three useful applications of Micro-Electro-Mechanical Systems (MEMS) (3 marks)

QUESTION TWO (20 MARKS)

- a) State ideal characteristics of an ideal operational amplifier (4 marks)
- b) 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:
(10 marks)
- i. Street lamps,
 - ii. Camera
 - iii. Light meters
 - iv. Burglar alarm circuits
 - v. Counting packages moving on a conveyor belt
- c) Investment in instrumentation systems for robotics and artificial intelligence applications should be enhanced in a developing country like Kenya. In view of the current security status within Kenya and Africa as a whole, discuss the need for investing in robotics and artificial intelligence technologies (6 marks)

QUESTION THREE (20 MARKS)

- a) State any three advantages of the fiber optics sensor (3 marks)
- b) With illustrations, discuss the major types of proximity sensors (6 marks)
- c) Use a diagram to explain the principle of operation of any one 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 a typical analogue oscilloscope as an instrument of choice and sketch its corresponding measurement systems. Show physical quantities, forms of energies components receive/produce, and major parts (16 marks)

QUESTION FIVE (20 MARKS)

- a) In order to overcome inertia of the moving system of an indicating instrument, a damping torque is developed using a damping device attached to the moving system. By use a diagram, explain three damping conditions depicted by indicating instruments (12 marks)
- b) Damping torque is produced by various methods. Discuss four major methods (8 marks)