UNIVERSITY OF GHANA

BSC ENGINEERING SECOND SEMESTER EXAMINATIONS: 2015/2016

SCHOOL OF ENGINEERING SCIENCES
FPEN 404: FOOD PROCESS CONTROL (3 CREDITS)

TIME ALLOWED: TWO (2) HOURS

Answer all Questions in Section A and ONE (1) from Section B

SECTION A

1. What is the importance of process control in food process industry? Illustrate your answer with examples from the food process industry.

2. Describe the following controls indicating how they are implemented, their advantages and limitations:
   i. Feedback control
   ii. Cascade control
   iii. Selective control
   iv. Fuzzy control
   v. Ratio control
   vi. Batch control
   vii. Ratio control

3. a. What is a transmitter in process control and give examples of transmitters.
   b. Define (i) a transducer, (ii) a converter
   c. Write short notes on the following: (i) pneumatic signals, (ii) analog signals and (iii) digital signals.

4. Give simple definition of the following as used in process control applications. Draw the block diagram of a feedback control system to illustrate where necessary.
   i. Primary feedback signal
   ii. Open-loop system
   iii. Frequency response
   iv. Measured variable
   v. Control algorithm
   vi. Closed-loop feedback control system
   vii. Digital-to-analog (d/A) converter
   viii. Load disturbance
   ix. Programmable logic controller (PLC)
   x. Feedback path

5.
a. Describe the main components of a feedback process control system. Hint use a block diagram to illustrate.
b. What is the advantage in selecting a PID controller over a proportional controller.
c. What are the basic modes in process control theory, in each case give the fundamental design equation.

SECTION B

6. The process control system in the food processing factory where you are working may largely be characterised as a linear first order control system, if it is subjected to the following forcing functions what will be the output signals?

   i. step function;
   ii. ramp function;
   iii. parabolic function; and
   iv. sinusoidal function

7. The purpose of a controller is to operate either as a servo-type controller or a regulator-type controller.
   a. Define the following ratios for a servo-type operating as a simple feedback control system with no load changes in the process:

      i. control ratio,
      ii. primary feedback ratio, and
      iii. error ratio

   b. Determine the following ratios for the regulator-type control system when it subjected to only a variable load:

      i. primary feedback ratio,
      ii. error ratio, and
      iii. control ratio.

   In each case draw a block diagram of the control system and label its component parts.