ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE, NIGERIA

DEPARTMENT OF
MECHANICAL, AUTOMOTIVE AND PRODUCTION ENGINEERING

SECOND SEMESTER EXAMINATIONS

2016/2017 ACADEMIC SESSION

COURSE:	MEE 310 – Control Systems (3 Units)
CLASS:	300 Level Mechanical Engineering
TIME ALLOWED:	3 Hours
INSTRUCTIONS:	Answer any five questions

HOD'S SIGNATURE

Date: July/August, 2017

Question 1

(a) State the circumstances under which a system is considered stable? **(5 marks)**

(b) Consider the system where the transfer function of the plant is given. In this system, a negative unit feedback is used.

$$G_c(s) = K, \quad G_p(s) = \frac{s+3}{s(s+1)(s+5)}$$

Using Hurwitz criterion, determine the stability criterion for the closed – loop system in term of the controller gain K. **(7 marks)**

Question 2

(a) Sketch the four basic interconnections used to combine the elementary block diagrams in control system **(4 marks)**

(b) Consider the model in the S-domain of a simple spring-mass-dashpot system being acted on by an input force applied to the mass, as shown in Figure Q2(b). Obtain the input-output transfer function relating the output X to the input F, using block diagram algebra. **(8 marks)**
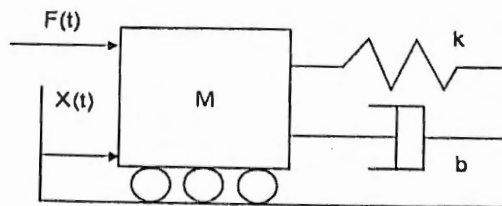

Figure Q2(b).

Question 3

    (a) Enumerate five types of components in a control system   **(3 marks)**

    (b) What do you understand by control system design and tuning?   **(3 marks)**

    (c) Discuss the basic three common approaches for improving control system performance

                                                    (6 marks)

Question 4

    (a) Briefly explain digital control system.   **(3 marks)**

    (b) What are the benefits of using digital control system?   **(3 marks)**

    (c) Define the following terms: PI, PD, and PID controllers   **(6 marks)**

Question 5

    (a) Explain the role of a controller in a closed loop control system.   **(3 marks)**

    (b) The feedback system has an open loop transfer function given as

$$G(S)H(S) = \frac{K(1-S)}{S(S^2 + 5S + 9)}$$

    using Routh criterion, determine the maximum value of K for the closed loop system to

    be stable.   **(9 marks)**

Question 6

    (a) Differentiate between open-loop and closed-loop control systems?   **(5 marks)**

    (b) Considering a unit feedback control system with the closed loop transfer function

$$\frac{C(S)}{R(S)} = \frac{Ks + b}{s^2 + as + b}$$

    Determine the open-loop transfer function.   **(7 marks)**

Question 7

    (a) Define the term transient response.   **(2 marks)**

    (b) Consider a linear first order dynamic system for which the governing equation is given by

    $\tau \dot{y} + y = f(t)$, where $\tau > 0$ is a time constant. Derive the expression for forced response of the system for the following units:

        (i) step input   **(5 marks)**

        (ii) impulse input   **(5 marks)**