GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Mechanical Engineering

BSc Engineering Degree
Semester 4 Examination – September 2021
(Intake 37 - ME, MC, MR, AE, EE, ET)

ME 2213- CONTROL SYSTEMS ENGINEERING

Time allowed: 3 hours 21st September, 2021

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on pages 3 and 4

Answer **ALL** questions

This is a closed book examination

This examination accounts for 70% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

This Page is Intentionally Left Blank

Question 01

(a) Briefly explain the elements of a closed loop system.

[05]

(b) A temperature control system operates by sensing the difference between the thermostat setting and the actual temperature and then opening a fuel valve an amount proportional to this difference. Draw a functional closed loop block diagram representing the input and output transducers, the controller, and the plant. Further, identify the input and output signals of all subsystems previously described.

[20]

Question 02

Figure Q2 shows the block diagram of a position control system.

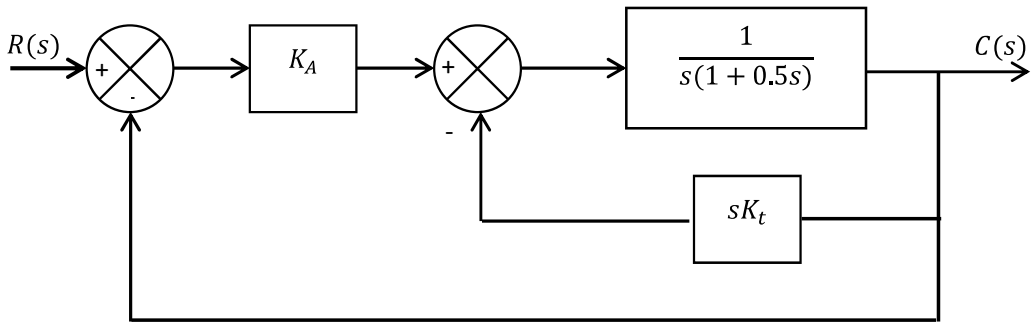

Fig. Q2: Position control system

(a) In the absence of K_t $(K_t = 0)$ determine the damping ratio of the system for amplifier gain $K_A = 5$. Also find the steady state error to unit ramp input.

[10]

(b) Find suitable values of the parameters K_A and K_t so that the damping ratio of the system is increased to 0.7 without affecting the steady state error obtained in (a).

[15]

Question 03

(a) State the Routh-Hurwitz Criterion.

[05]

(b) The characteristic equations for certain feedback control systems are given below. In each case, determine the range of values of K for the system to e stable.

(i) $s^4 + 20Ks^3 + 5s^2 + 10s + 15 = 0$

[10]

(ii) $s^3 + 2Ks^2 + (K + 2)s + 4 = 0$ **[10]**

Question 04

A system oscillates with frequency ω, if it has poles at $s = \pm j\omega$ and no poles in the right half s-plane. Determine the values of K and μ so that the system shown in Figure Q4 oscillates at a frequency 2 rads^{-1}.

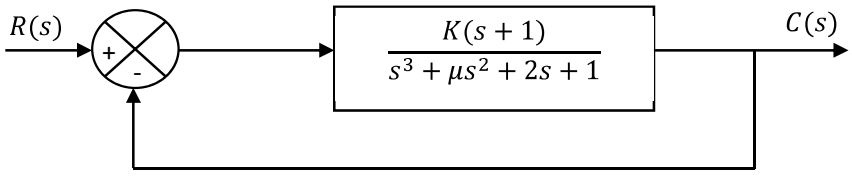

Figure Q4

[25]

End of question paper