VIETNAM NATIONAL UNIVERSITY, HANOI
UNIVERSITY OF ENGINEERING AND TECHNOLOGY

FINAL EXAM – SEMESTER II, 2019-2020
CONTROL ENGINEERING - ELT 3051 26. Duration: 90 minutes

The exam includes one page. Students are not allowed to use any documents

Q1: The differential equation of system is shown as follow

$$\frac{d^2y(t)}{dt^2} + 4{,}2\frac{dy(t)}{dt} + 36y(t) = 36x(t)$$

a. Find the transfer function of system
b. Write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of response.
c. Determine the settling time, peak time and percent overshoot of the second order system.

Q2: A unity feedback system has the following forward transfer function:

$$G(s) = \frac{10(s+10)(s+20)}{s(s+15)(s+25)}$$

a. Find the steady state error for the following inputs: *u(t)*, *tu(t)*, $t^2u(t)$
b. Determine the stability of the feedback system?

Q3: Given a unity feedback system that has the forward path transfer function

$$G(s) = \frac{K}{(s+2)(s+4)(s+6)}$$

a. Sketch the root locus and find the range of *K* for stable system.
b. The Nyquist diagram of the open loop system with *K* = 100 is shown in the Figure 1.
- Using the Nyquist criterion, find out whether the closed loop system is stable or not?
- Determine the gain and phase margin of closed loop system?

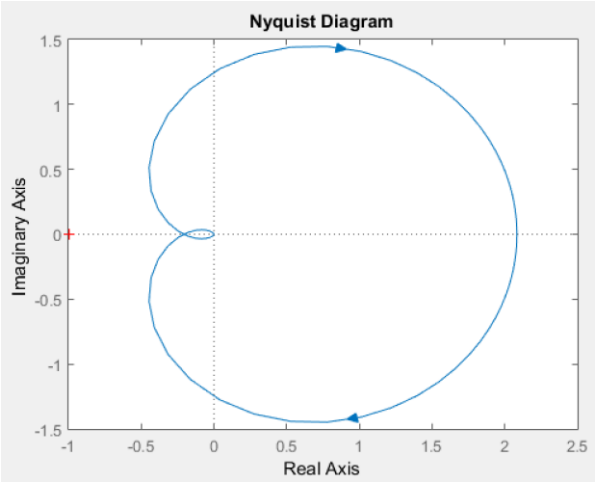

Figure 1

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SOLUTION FINAL EXAM – SEMESTER II, 2019-2020
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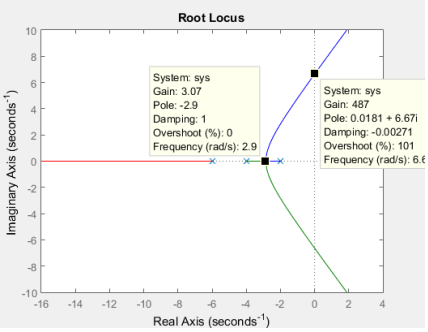
Q1 (3 marks):
a. $36/s^2+4.2s+36$
b. $s_{1,2}$ = -2.1 +- j 5.6
$y(t)$= 1* A exp(-2.1t)*cos(5.6t+phi)
c. T_p =1.31, OS = 30.9%, T_s = 1.89 s

Q2 (2 marks)
a. e(step)=0, e(ramp)=constant, e(parabol)= infinite
b. The closed loop system is unstable

Q3 (5 marks)



- The system is stable
- GM = 13.6 (db) w_c =6.63 rad/s. PM = 72.7 w_p= 2.54