



UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 6 Examination in Engineering: November 2014

Module Number: ME 6319

Module Name: Automatic Control Engineering

[Two Hours]

[Answer all questions, each question carries five marks]

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- Q1. Automotive cruise control systems are used to hold the vehicle speed steady at a set value especially in long runs to prevent driver fatigue. After switched "ON" by the driver, this system takes the control of the gas throttle using an electronically controlled stepper motor, and keeps the vehicle speed constant. This system requires speed sensors to measure the controlled vehicle speed.
- a) Identify basic elements of the cruise control system (reference input, output, actuator, controller, sensor, plant), and briefly explain the role of each element. [2.0 Marks]
 - b) List any possible disturbances to the system during operation. [1.0 Marks]
 - c) Draw a simple block diagram of the system clearly indicating the basic elements represented by each block. [2.0 Marks]
- Q2. Consider the mechanical system shown in Figure Q2 with usual notations.
- a) Obtain the mathematical model of the system. [3.0 Marks]
 - b) Find the transfer function between F_e and x_1 . [2.0 Marks]
- Q3. Use the "block diagram reduction method" to simplify the block diagram (with usual notations) shown in Figure Q3 into a single block relating $Y(s)$ to $R(s)$. [5.0 Marks]
- Q4. Determine the values of ' K_1 ' and ' K_2 ' of the closed loop system (with usual notations) shown in Figure Q4; so that the maximum overshoot in unit step response is 25% and the peak time is 2 sec. Take $J = 1 \text{ Kg-m}^2$. [5.0 Marks]

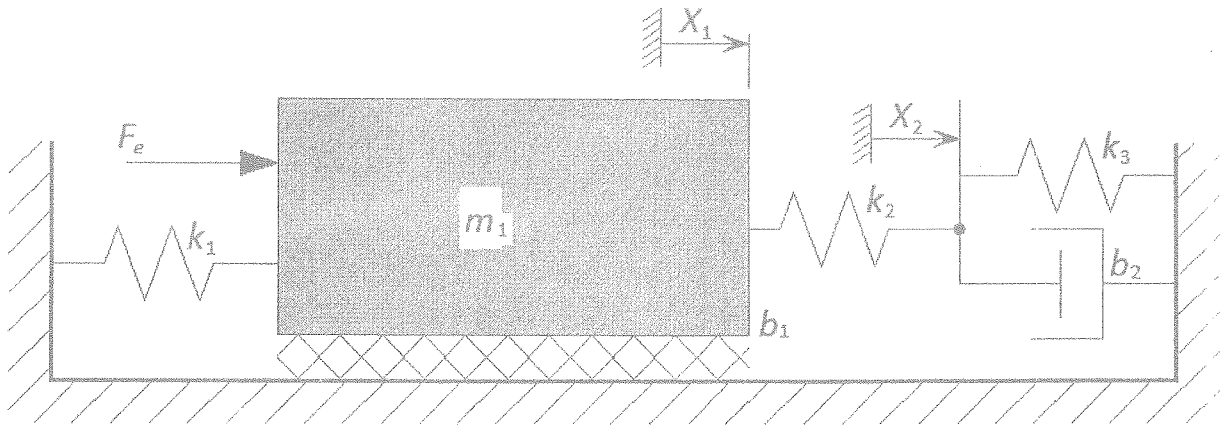


Figure Q2

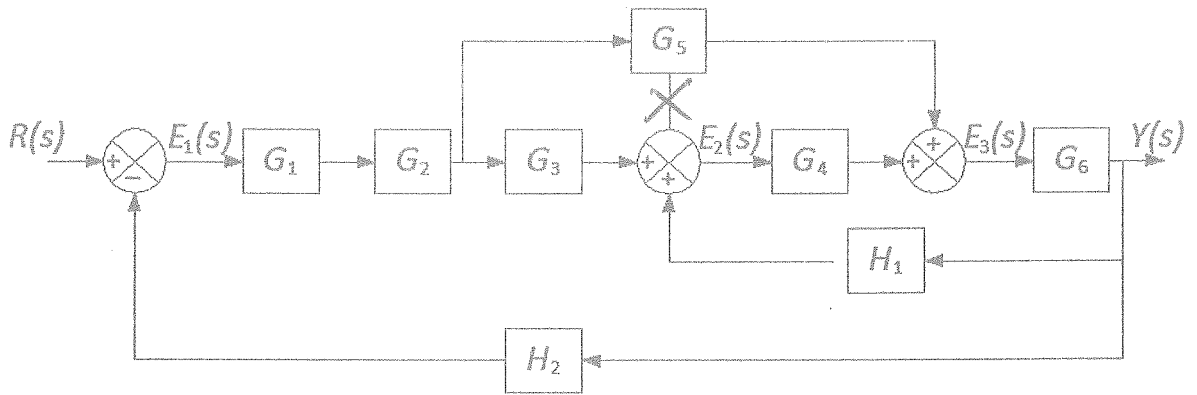


Figure Q3

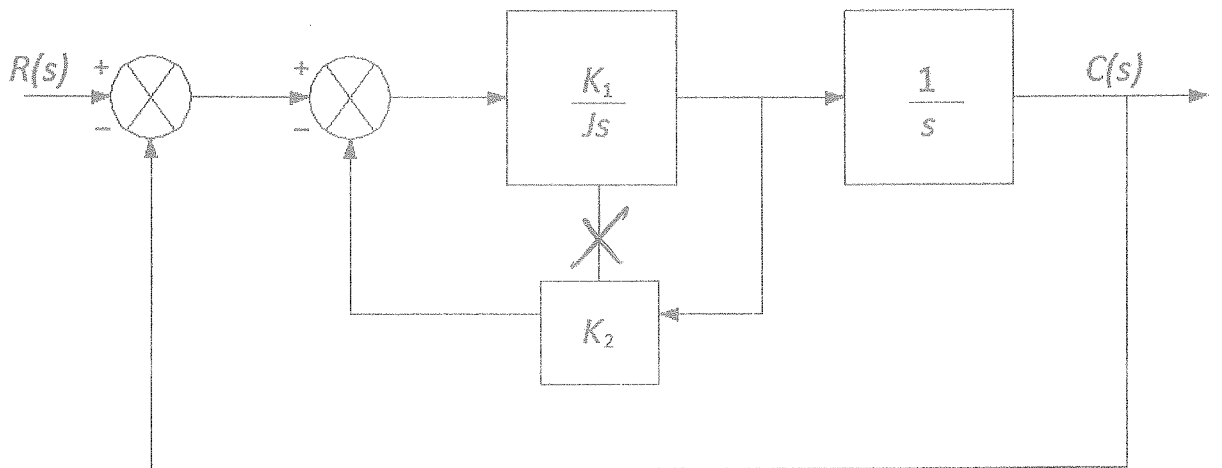


Figure Q4