COLLEGE OF ENGINEERING, PUNE – 5.

End Semester Examination

(ME 404) Automatic Control System

Programme :- **B.Tech. (Mechanical)**
Specialisation :- Mechanical
Year :- 2013 – 14

Date :- 18th Nov 2013
Max. Marks :- 60
Duration :- 03 hr

Instructions: - 1) Figures to the right indicate full marks
2) Draw neat figures wherever required

Q.1 Justify with examples, elaborations & figures for **any five** from the following statements. **[10]**

1) Discrete data control systems are also known as sampled data control systems.
2) D'Alembert's principle a modified version of Newton's second law of motion which is similar to Kirchhoff's law in electrical networks can be used for formulating the system equations.
3) The transfer function for mechanical networks looks identical to transfer functions for electrical networks.
4) It is rather cumbersome to use Block Diagram algebra to get transfer function than in comparison with Signal Flow Graph.
5) The steady state error reflects the accuracy of the system.
6) Bode plot is effective graphical representation of G(j*w*) for designing the control system, which is obtained from the transfer function G(s) by replacing *s* by j*w*.
7) Gain Margin and phase margin are the relative stability measures and are indicative of the nearness of the closed loop poles to the j*w* axis.
8) Routh – Hurwitz stability criterion determines all the roots on the j*w* axis, so that their multiplicity can be found out.

Q.2 a) Reduce the given block diagram of fig. 1, to its simple form and hence obtain C(s) / R(s). **[05]**

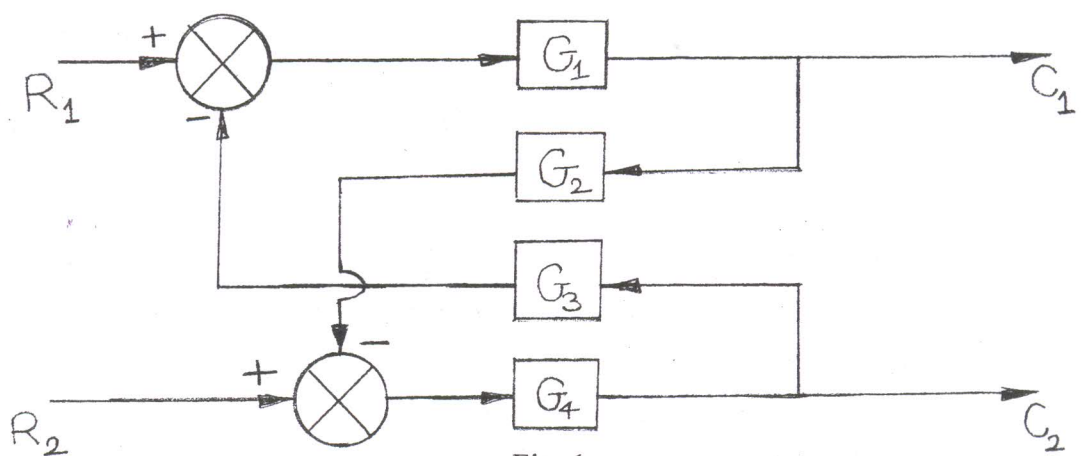

Fig. 1

OR

(P.T.O.)

a) Obtain the Transfer function for the system as shown in the fig. 2, using Mason's gain formula. **[05]**

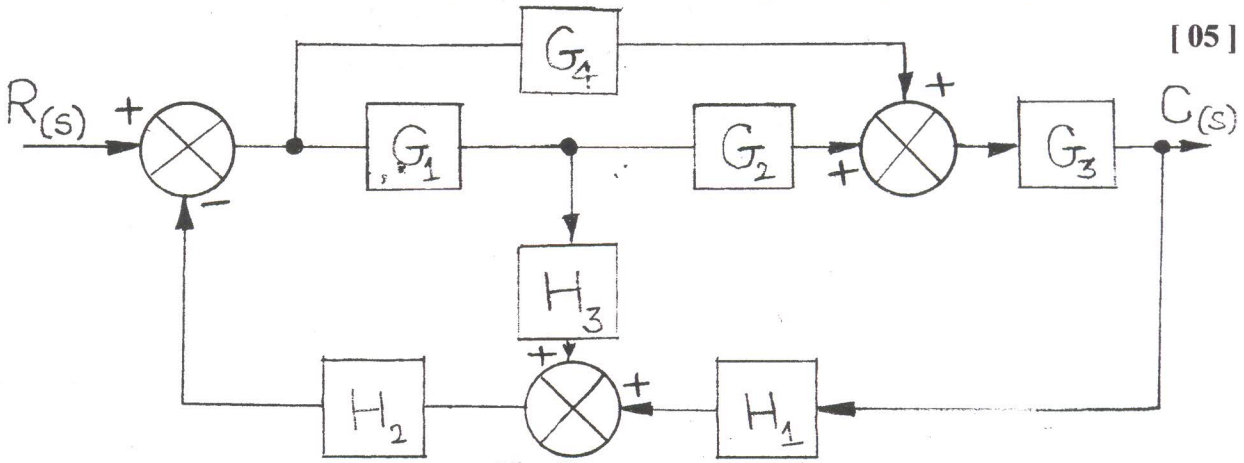

Fig. 2

b) Draw the signal flow graph for the block diagram given in the fig. 3 and obtain the transfer function for the same system. **[05]**

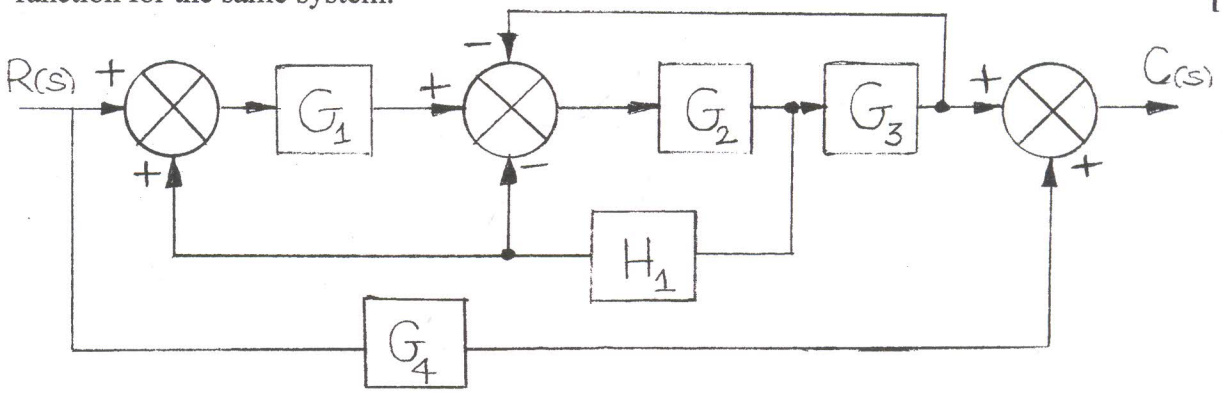

Fig. 3

Q. 3 a) Analyze RLC series & parallel circuits by using of Kirchhoff's voltage & current laws. **[05]**

b) Discuss the advantages and the disadvantages of the pneumatic actuators. Describe the principal of working of Flapper-Nozzle system. **[05]**

OR

b) Explain the principal of operation of AC servo motor for its application in the electrical systems to be used for controlling? Also explain the reasons of its preferential use in the heavy duty devices and non suitability for the various other types of control applications. **[05]**

Q.4 a) Elaborate the use of fly ball governor integrated with hydraulic actuator to use it for integral control system. Draw the block diagram and circuit diagram of such system. **[05]**

OR

a) Discuss a term in detail with neat sketch "PID Control system with Tachometric Feedback". **[05]**

b) List the various types of standard test signals and describe the unit step response of a second order system and its features. **[05]**

(P.T.O.)

Q. 5 a) Determine the general equation for the transient response of a second order system to a unit step-function change which occurs at t = 0. The operational form of the differential equation is

$$y(t) = (\omega_n^2 / D^2 + 2\zeta \omega_n D + \omega_n^2) f(t)$$

Consider the initial conditions at zero / null value. **[05]**

b) A unity feedback control system has an open loop transfer function given as

$$G(s) = \frac{2(s+8)}{s(s+2)}$$

1) Obtain the closed loop transfer function C(s) / R(s) and find there from system damping factor and natural frequency and unit peak overshoot.

2) Calculate c (t) for unit step input

3) Calculate e_{ss} for unit ramp input.

4) Remove the zero s = - 15 and increase the gain to 25. Find ζ and ω_n.

5) Calculate C (t) for unit step input. **[05]**

Q.6 a) Draw the Bode plot for the transfer function as given below. (Draw an appropriate semi-log graph on the answer sheet for the construction of the plot.) **[05]**

$$G(s) = K s^2 / (1 + 0.2 s) (1 + 0.02 s)$$

Determine the value of K for the gain cross-over frequency to be 5 rad/sec.

b) Explain the significance of the Nyquist Stability criterion. Also explain that how it can be helpful for improving the system performance by reshaping the polar plot. **[05]**

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