Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 161905 **Date: 19/05/2012**

Subject Name: Control Engineering

Time: 10:30 am – 01:00 pm **Total Marks: 70**

Instructions:

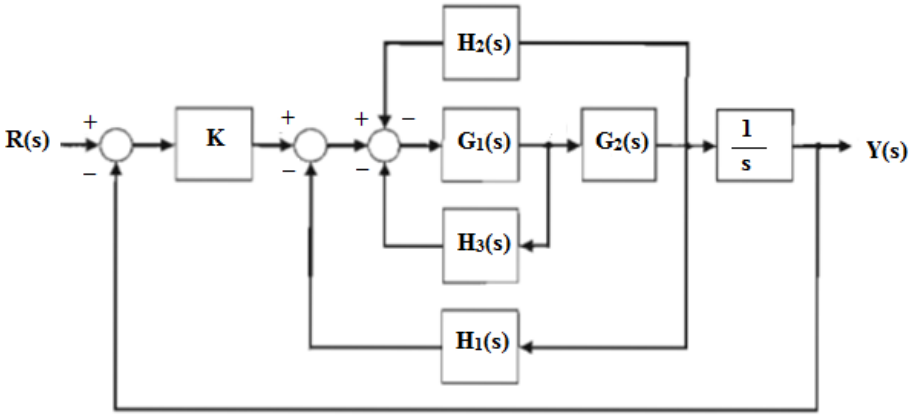
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** i. Draw a general block diagram of an automatic control system. **02**

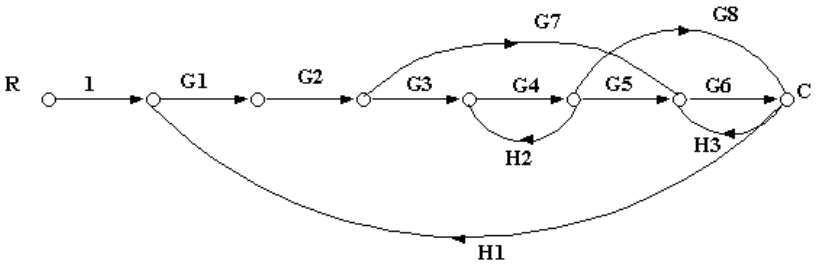
ii. Differentiate the following: **05**

- Open loop Vs close loop control systems.
- Linear time invariant Vs Linear time varying systems

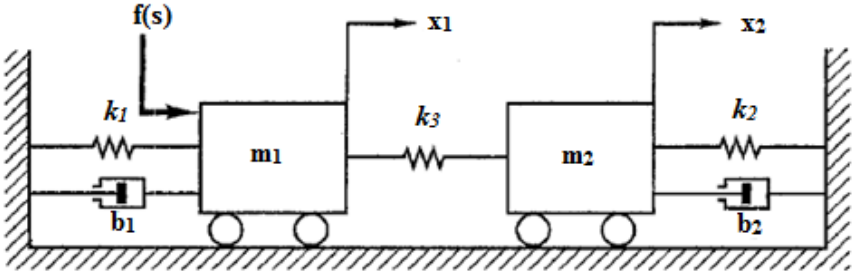
(b) A control engineer, N. Minorsky, designed an innovative ship steering system in the 1930s for the U.S. Navy. The system is represented by the block diagram shown below, where *Y(s)* is the ship's course; *R(s)* is the desired course. Find the transfer function *Y(s)/R(s).* **07**



Q.2 **(a)** For the signal flow graph of a multiple loop system shown in figure, determine C(s)/R(s) using Mason's gain formula. **07**

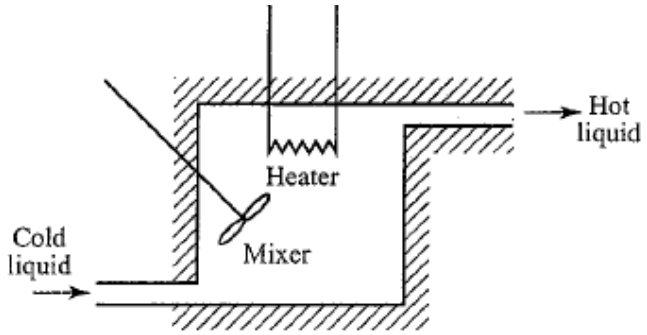


(b) Define transfer function. State the limitation of the transfer function. **07**
Obtain the transfer functions $x_1(s)/f(s)$ and $x_2(s)/f(s)$ of the mechanical system shown below. Draw a free body diagram of each mass.



OR

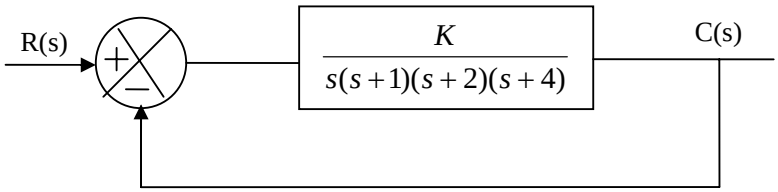
(b) Write the differential equations governing the thermal system. Draw the block diagram and derive the transfer function between temperature of out flowing liquid and heat input rate. **07**



Q.3 **(a)** Define following terminologies in reference to transient response specifications of second order system using neat sketch: **07**

i. Peak time
ii. Rise time
iii. Delay time
iv. Settling time
v. Maximum overshoot
vi. Steady state error

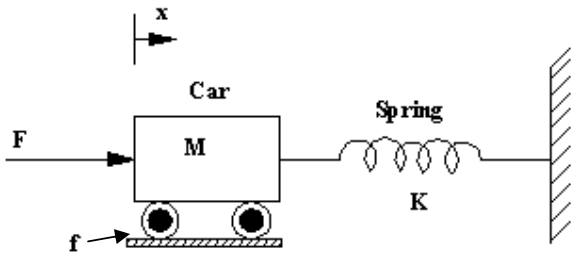
(b) Sketch the root locus and its asymptotes for a unity feedback system shown below: **07**



OR

Q.3 **(a)** Figure shows a system in which a car of mass 1 kg. is attached to the wall through the spring. If the spring constant K=140 N/m, the coefficient of friction f=10N-sec per m and the step force applied is 10 N. Calculate, **07**

(i) The final displacement of the car.
(ii) The peak displacement of the car and
(iii) The duration of time after which the peak displacement is reached.



(b) Consider the following characteristic equation: **07**

$$s^4 + Ks^3 + s^2 + s + 1 = 0$$

Determine the range of K for stability using Routh's stability criterion.

Q.4 **(a)** 1) State the various components of any hydraulic circuits. Name the various types of pumps commonly used for hydraulic power purposes. **04**

2) Compare between hydraulic and pneumatic control systems. **03**

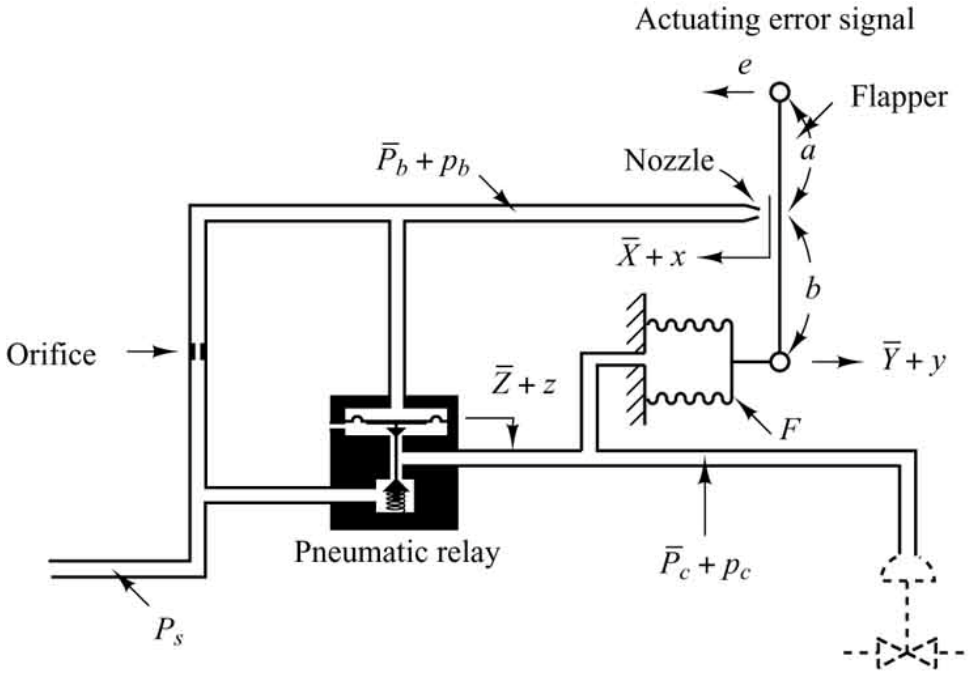
(b) Explain the construction, working and application of a hydraulic intensifier. **07**

OR

Q.4 **(a)** State the various types of Industrial controllers and describe any two of them. **07**

(b) Derive the transfer function of pneumatic controller shown in figure. **07**

- Name the type of contoller.
- State the assumptions made in the analysis of this controller.
- Highlight the role of nozzle-flapper amplifier and pneumatic relay.



Q.5 **(a)** Describe the working of a field controlled DC motor and derive its transfer function. **07**

(b) Write a short notes on: **07**

i. Feed water control system for Boiler

ii. Hydraulic controls of a machine tools

OR

Q.5 **(a)** i. Which are the various components of programmable logic controllers? **02**

ii. Write various applications of PLC in modern industry. **02**

iii. What is ladder diagram? Explain it with suitable example. **03**

(b) (i) Define following terminologies: **07**

Fuzzy sets, Fuzzification, Defuzzification, Linguistic variables

(ii) List various applications of Fuzzy Logic controller.

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