B.E. (CST) Part-II 4th Semester Examination, 2010

Control and Instrumentation
(EE-406)

Time : 3 hours **Full Marks : 70**

Use separate answer-script for each half.
Answer SVC questions, taking THREE from each half.
Two marks are reserved for neatness in each half.

FIRST HALF

a) **Find the Laplace transform of the following functions**

$f(t) = 0$ for $t < 0$

$= \sin\omega t.\cos\omega t$, for $t > 0$.

b) **Find the inverse Laplace transform of**

$$F(S) = \frac{(s+1)}{(s^2+s+1)}$$

c) **Draw one electrical circuit which is analogous to the following mechanical system. Mention analogous quantities.** |3+4+4|

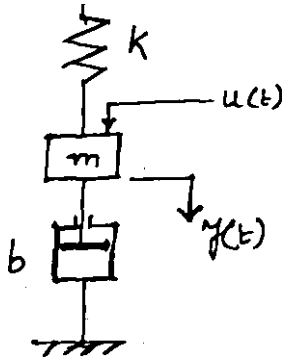

Fig.-1 (Mechanical System^

2. a) **Let the differential equation of a first order system is**

$$J\frac{d\omega(t)}{dt} + B\omega(t) = T(t)$$

where $\omega(t)$ = angular velocity

$T(t)$ = Input torque

B = damping coefficient

J = Moment of Inertia

Find the transfer function of the system. Draw the response of the given system for ramp input.

b) What is Routh's criterion? How does it determine the stability of a system? (7+41

3. a) Explain the term "damping ratio" (£) of a system. Mention its range.

b) Prove for a first order system, the response to the derivative of an input signal can be obtained by differentiating the response of the system to the original signal.

c) Applying Routh's stability criterion, comment on the stability of the following system $s^3 + s^2 + s + 2 = 0$. [3+4+41

4. a) What is the difference between a continuous time and a discrete-time system?

b) Find the Closed Loop Transfer function of the following system of Fig.-2 using Mason's Gain Rule! |3+8|

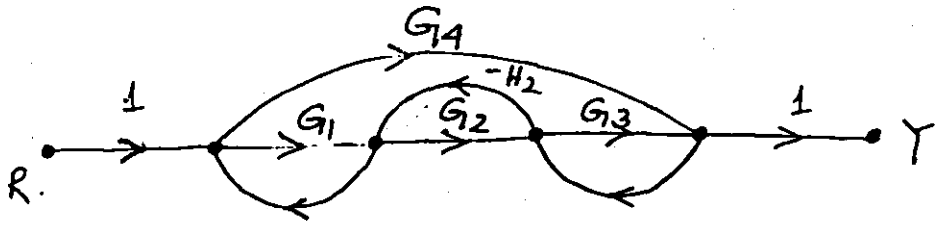

Fig.-2 (Signal flow graph)

5. Draw the root locus plot of the system whose characteristic equation is expressed as

$$1 + \frac{}{s(s+4)(s^2+2s+3)} = 0 \; ; \; k > 0 .$$ |"

SECOND HALF

6. a) Define "resolution" and "sensitivity".

b) Give two examples for each of 'active* and 'passive' transducers.

c) A LVDT has an output of 6V (rms) when the displacement is 0.4×10^{-3} mm. Determine the sensitivity of the LVDT. A 10 V voltmeters with 100 scale divisions is used to read the output. Two tenth of a divisions can be estimated with case. The above arrangement is used in a pressure transducer for measuring the deflection of a diaphragm. It is deflected through 0.5×10^{-3} mm by a pressure of $1000 N/m^2$. Determine the sensitivity and resolution of the whole set-up. I(l'/ix2)+2+61

7. a) Compare the relative advantages and disadvantages of (i) RTD, (ii) Thermister and (iii) Thermo-couple as temperature sensors.

b) The resistance temperature relationship of a thermister is given by : RJ_2 = P' $O^F T_2 \sim$ ^T,)- If the value of P is 400°K and the resistance of thermistor is 200 kQ at -100°C. Find the value of resistance at 400°C. Find the ratio of these two resistances. Also compute the ratio of resistances for platinum wire over the same temperature range. Platinum has a resistance temperature co-efficient of 0.0039/°C. |6+5]

8. a) A semiconductor strain-gauge having a resistance of 1000Q and a gauge-factors of -133 is subjected to a compressive strain of 500 micro-strain. Calculate the new value of resistance of the gauge.

b) A displacement capacitive transducers uses a differential arrangement with two outer plates which are fixed and a centre plate which is movable. The distance between fixed and movable plates is 5 mm when no displacement is applied. A voltage of 1000 V (rms) is applied across the fixed plates. Find the differential output voltage, if a displacement of 0.01 mm is applied to the central plate. 15+6]

9. a) Describe any two methods of analog to digital (A/D) conversion techniques.

b) Find the output of 4 bit successive approximation type A/D converter to a 3V input, if reference voltage is 5 V. |6+5|

10. Write short notes on <u>any two</u> : (5'/ix2|

a) D/A Converter,

b) Digital transducer,

c) LVDT.