PG/IIIS/ELC-302/13

M.Sc. 3rd Semester Examination, 2013

ELECTRONICS

(Control System and Instrumentation)

[Theory]

PAPER — ELC-302

Full Marks : 50

Time : 2 hours

Q.No.1 and answer any **three** from the rest

The figures in the right hand margin indicate marks

1. (a) What is the difference between open loop control system and closed loop control system. Give one example for each.

   (b) Define CMRR for ideal an Op-amp.

   (c) Why negative feedback is preferred over positive feedback in a closed loop system.

(d). Define poles and zeros of a function of the complex variable and explain its significance in control system study.

(e) What is the need for inserting isolation between the signal generator output and the oscillator in a simple signal generator ? 2 × 5

2. (a) A unity feedback system is characterised by an open loop transfer function is

$G(s) = \dfrac{k}{s(s+10)}$. Determine k so that system will have damping ratio 0·5. For this value of k determine settling time, peak overshoot and time to peak overshoot for a unit step input.

(b) For the characteristic equation of feedback control system is given by

$$s^4 + 25s^3 + 15\,s^2 + 20s + k = 0$$

Determine the range of k for stability. Determine the value of k so that the system is marginally stable and find the frequency of sustained oscillation. 5 + 5
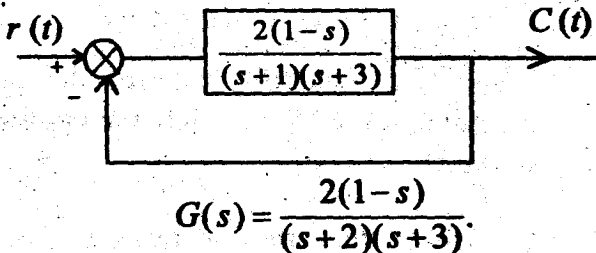
3. (a) A typical type 'O' system has transfer function given,

$$G(s) = \frac{k}{(1+ST_1)(1+ST_2)(1+ST_3)}$$

sketch its polar plot.

(b) For the system shown in figure below, sketch the Nyquist plot (roughly) for $k=2$ and use the Nyquist criterion to determine whether the closed loop system is stable. 3 + 7

r (t) $\frac{2(1-s)}{(s+1)(s+3)}$ C (t)

$$G(s) = \frac{2(1-s)}{(s+2)(s+3)}.$$

4. (a) For the signal flow graph shown in Fig.2 (a) determine the ratio x_5/x_1. Use Mason's gain formula for signal flow
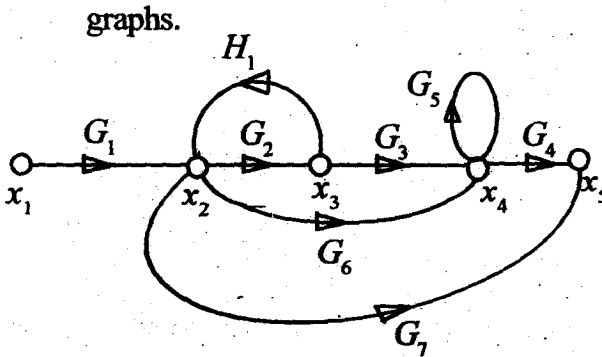
graphs.

Fig.2(a)

(b) State Routh's Stability criterion. The characteristic equation of a system is given by

$$s^3 + 3ks^2 + (k + 2)s + 4 = 0$$

Using Routh's stability criterion, determine the range of k for which the system is stable. $5 + (1 + 4)$

5. (a) Determine the damping ratio, undamped natural frequency, delay time, rise time, peak time and maximum overshoot for the second order system whose characteristics equation is given by

$$s^2 + 2 \cdot 5s + 10 = 0$$

(b) How is the electron beam focused to a fine spot on the face of the Cathode ray tube ?

(c) How does the digital storage oscilloscope differ from the conventional storage oscilloscope using a storage Cathode ray tube.   6 + 2 + 2

6. (a) Describe the basic elements of a function generator which generates square, triangular and sine waveshapes with a neat diagram.

(b) Find the Z-transform of the discrete sequences generated by mathematically sampling (at uniform time interval T) the continuous-time function of e^{-at}.   7 + 3

[*Internal Assessment* — 10 Marks]

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