BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2024)

CLASS: BTECH   SEMESTER : V
BRANCH: EEE   SESSION : MO/2024

SUBJECT: EE351 CONTROL THEORY

TIME: 02 Hours   FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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Q.1(a)   With examples differentiate between (i) Open loop and closed loop systems (ii) [2]   1   1,2
          linear time variant and linear time invariant systems.

Q.1(b)   Explain the effect of feedback on (i) stability and (ii) sensitivity of the system.   [3]   1,3   2

Q.2(a)   Using block diagram reduction technique, obtain the overall gain of the system   [2]   1   3
          shown in Fig. 1.

Q.2(b)   Draw the signal flow graph of the system given in Fig. 1 and determine C/R. Also   [3]   1   3,4
          verify the result obtained in part (a).

Q.3(a)   Distinguish between transient response and steady state response of the system.   [2]   3   3,4
          The forward path transfer function of a system with unity feedback is given by
          $G(s) = \frac{4}{s(s+6)}$. Obtain the expression for unit step response of the system.

Q.3(b)   Consider the mechanical system given in Fig. 2. Using f-v and f-i analogy, draw the   [3]   1   3
          analogous electrical system. Also write the relevant equations.

Q.4(a)   With reference to time response of second order system for step input, define and   [2]   3   1,2
          indicate the following terms on the plot: rise time, peak overshoot, delay time,
          settling time.

Q.4(b)   For a unity feedback system, forward path transfer function is given by $G(s) =$ [3]   3   4,5
          $\frac{20}{s(s+2)(s^2+2s+2\ )}$.
          (i)   Obtain the characteristic equation of the system.
          (ii)   Determine the type and order of the system.
          (iii)   Determine the steady state error of the system, when the inputs are (a)
                  5 (b) 5t (c) $\frac{3t^2}{2}$.

Q.5   For a unity feedback system, open loop transfer function is given by $G(s)H(s) =$ [5]   2,3   4,5
          $\frac{K}{s(s+2)(s^2+6s+25)}$
                  a. Sketch the root locus for $0 \leq K \leq \infty$.   3
                  b. At what value of K the system becomes unstable.   1
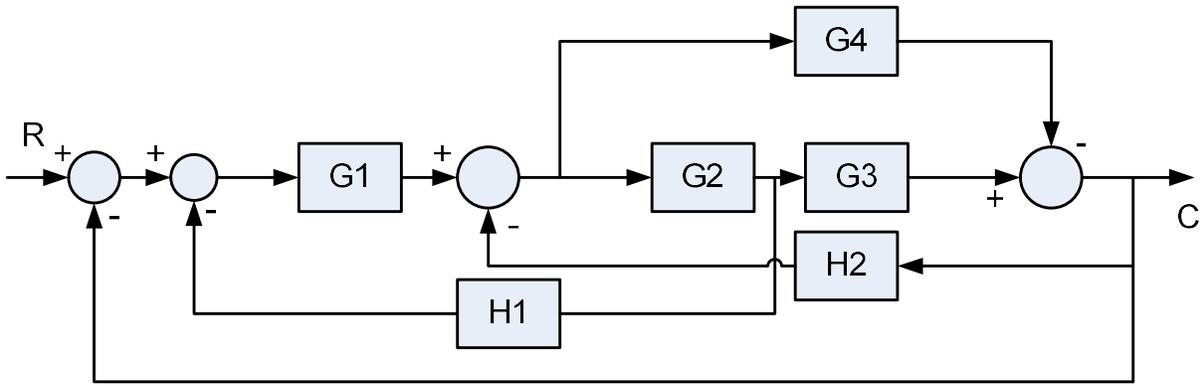   c. At this point of instability, determine the frequency of oscillation of the 1
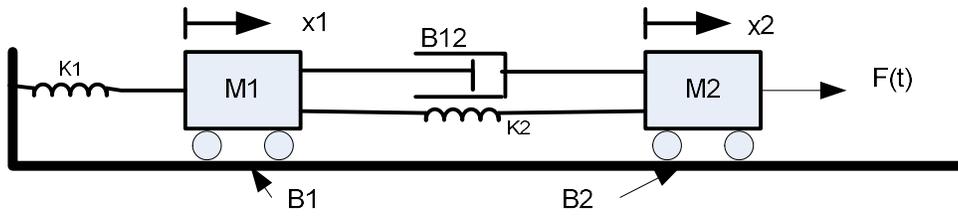   system.

PTO

Fig. 1

Fig. 2

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