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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
GRADE IMPROVEMENT / MAKE UP EXAMINATIONS, AUGUST 2021

LINEAR CONTROL THEORY [ELE 2253]

Time: 2 Hours **Date: 13 August 2021** **Max. Marks: 40**

Instructions to Candidates:

- Answer **any four** full questions.
- Missing data may be suitably assumed.

1A For the mechanical system given shown in Figure Q1A, draw the mechanical equivalent network, and also find the transfer function $\frac{x_3(s)}{F(s)}$.

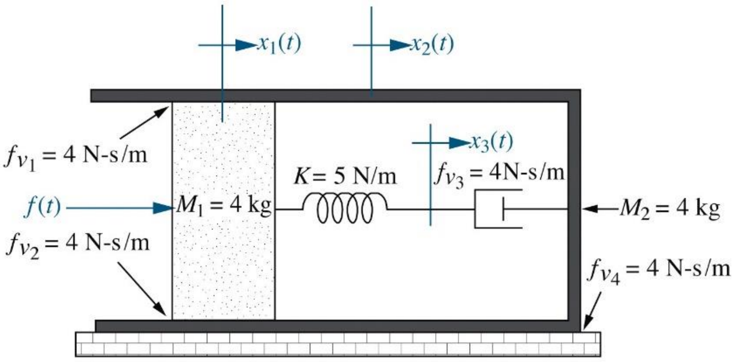

Figure Q1A **(06)**

1B For the unity feedback system with characteristics equation $T(s) = s^5 + 2s^4 + 3s^3 + 9s^2 + 2s + 10 = 0$, Using Routh Hurwitz criterion, find how many poles in the right half of s plane, in left half plane, and on the jω axis. **(04)**

2A For the unity feedback system with feed forward transfer function

$G(s) = \frac{K}{s(s+a)(s+30)}$, find the value of 'K' and 'a' and the location of third-order pole in order that the system can be approximated to a second order system with a peak overshoot of 16.3% and a peak time of 0.36sec. **(06)**

2B For the unity feedback system with feed forward transfer function G(s)=$\frac{K(s+2)(s+4)(s+6)}{s^2(s+5)(s+7)}$, find the value of K to yield a static error constant of 10,000. **(04)**

3A Draw the root locus plot for the unity feedback system whose feed forward transfer is given by

$$G(s) = \frac{K}{s(s+3)(s+6)}$$

Also, find the range of K for which the system has damped oscillatory response. **(06)**

3B Design the zero location of a phase lag compensator for the unity feedback system with feed forward transfer function $G(s) = \frac{221}{(s+1)(s+10)(s+3)}$, improve the finite steady state error by a factor 10. Pole location is assumed to be 0.01. **(04)**

4A Sketch the Nyquist plot and determine the value of K for which the closed loop system is sable.

$$G(s)H(s) = \frac{K(8+s)}{(6-2s)}$$ **(06)**

4B A unity feedback control system with,

$G(s) = \frac{245}{s(s+5)(s+15)}$ is operating with 20% overshoot. Obtain zero location of the PD controller satisfying 4 times reduction in settling time. **(04)**

5A Find the Transfer Function of the block diagram shown in Figure Q5A using block diagram reduction technique.

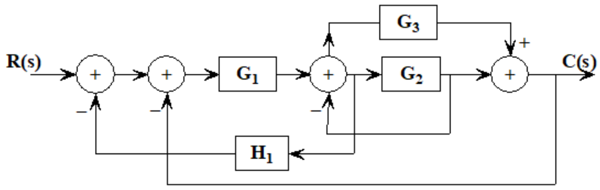

Figure Q5A **(05)**

5B A signal flow graph for the system is shown in Figure Q5B, determine the overall gain using the Mason's Gain formula.

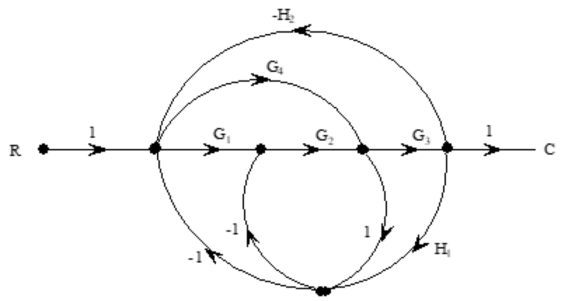

Figure Q5B **(05)**

6A Define the frequency domain specifications Phase margin and Gain margin **(04)**

6B For the asymptotic bode magnitude plot is as shown in Figure 6B

a) Find the gain margin (dB) of the system

If a proportional controller having a gain of 2 is added to the system, find the gain margin in dB.

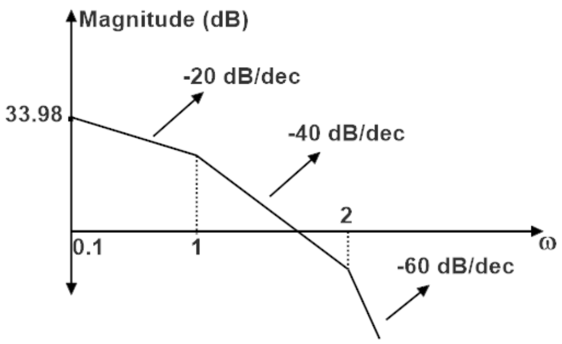

Figure 6B **(06)**