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Date: 12/05/2022

Exam No: _____

GANPAT UNIVERSITY
B. TECH SEM-IV (BM&I) REGULAR EXAMINATION- APRIL-JUNE-2015
2BM402: Control System Engineering

MAX. TIME: 3 HRS

MAX. MARKS: 70

- Instructions:** (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.
(4) Assume suitable data if necessary.
(5) wherever it is necessary explain with the help of diagram

SECTION: I

- Q.1** (12)
- (a) What is the purpose of gear trains system? For shaft 1 derive the mathematical model for gear trains system. 6
- (b) Define the terms: 1) System 2) Control 3) Control System, Also give the complete classification of Control System. 6

OR

- Q. 1** (12)
- (a) Define the TF. Derive the TF of Field controlled DC servo motor and draw its block diagram. 6
- (b) Give the purpose of analogous system. Explain all the analogous system in detail. 6
- Q.2** (11)
- (a) Derive the TF for the system shown in fig.1. 6
- (b) How many rules in block diagram reduction technique? Explain any four rules with statement and diagram. 5

OR

- Q.2** (11)
- (a) What is signal flow graph? Derive the overall gain of the system shown in fig.2 using the Mason's gain formula. 5
- (b) Enlist the benefit of feedback in control system Engineering. Derive the system sensitivity equation for S & S . 6
- Q.3** (12)
- (a) Give the steps to derive the mathematical model. 2
- (b) Draw the block diagram of DC position control system and explain it. 4
- (c) For the mechanical system shown in Fig.3 obtain an analogous electrical circuit based on Force-Voltage analogy. 4
- (d) Enlist all the methods to derive TF. 2

SECTION: II

- Q.4 (12)
- (a) For the first order control system and unit step i/p derive the time response, Time constant, error and steady state error. 4
- (b) Stability is defined for? Write the Routh stability criterion and explain the construction of Routh array. 4
- (c) Measurement conducted on servomechanism show the system response to be 4
 $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ when subjected to unit step input.
- 1) Obtain the expression for the closed loop TF.
 - 2) Determine the undamped natural frequency and damping ratio of the system.

OR

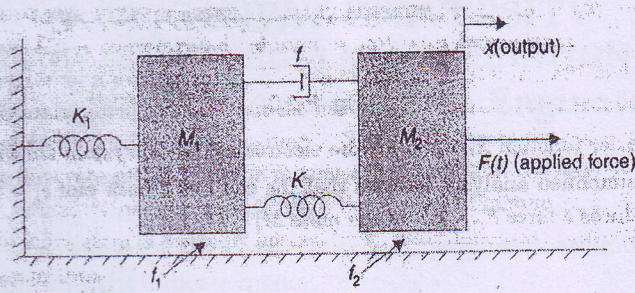
- Q.4 (12)
- (a) Draw the second order system response and indicate all the time response specification. Derive any one of the time response specification. 4
- (b) Enlist the difficulties associated with Routh stability criterion and also suggests their remedial solution. 4
- (c) A unity feedback system is characterized by an open loop TF $G(s) = K/s(s+1)$. Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine settling time, peak overshoot. 4

- Q.5 (11)
- (a) A unity feedback system has an open loop TF $G(s) = K/s(s^2+4s+13)$. Sketch the root locus plot of the system and determine the range of K for which system is stable. 6
- (b) Sketch the polar plot of the TF $G(s) = 1/s(1+s)(1+2s)$ and determine Gain margin and phase margin for system stability. 5

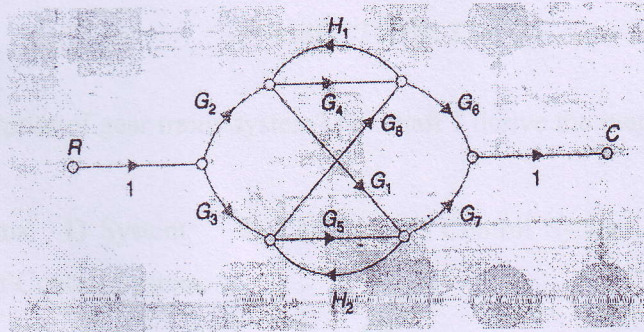
OR

- Q.5 (11)
- (a) Sketch the bode plot for $G(s) = 10/s(1+0.5s)(1+0.01s)$ showing magnitude in dB and phase angle in degree as a function of Log frequency and determine the system stability. 5
- (b) What is system stability? Draw the regions of root location for stable, unstable and limitedly stable systems. 6

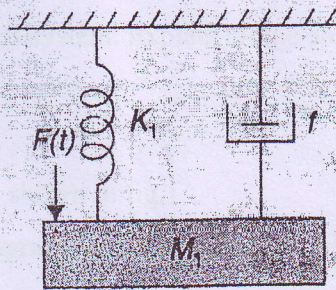
- Q.6 (12)
- (a) What is K_p, K_v, K_a for control system? Which are the disadvantages of steady state error constants? 4
- (b) Using Routh stability criterion decides the stability of the following system. 4
 1) $s^4 + 2s^3 + s^2 + 4s + 2 = 0$ 2) $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$
- (c) Define the terms 1) Root Locus 2) Polar plot 2
- (d) Write the advantages of root locus over Routh stability criterion. 2



Que. 2 (a) Fig.1



OR Que.2 (a) Fig.2



Que.3 (c) Fig.3

-----END OF PAPER-----