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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JAN 2023

Course Code: EEE 205
Course Name: CONTROL SYSTEMS
Program & Sem: B.TECH ECE / EEE

Date: 23 Jan 2023
Time: 09:30 AM-12:30 PM
Max Marks: 100
Weightage: 50%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted

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Part A [Memory Recall Questions]

Answer **all** the Questions. **Each** question carries **TWO** marks. (10Qx2M=20M)

1. Control theories commonly used today are classical control theory (also called conventional control theory), modern control theory, and robust control theory. In an open loop control system (C.O.No.1) [Bloom's level: Knowledge]
   (a) Output is independent of control input (b) Output is dependent on control input
   (c) Only system parameters have effect on the control output (d) none of the above
2. Electrical systems and mechanical systems are two physically different systems. The F-V and F – I are two types of electrical analogies of a mechanical translational systems The capacitance, in force-current analogy, is analogous to (C.O.No.1) [Bloom's level: Knowledge]
   (a) Momentum (b) velocity (c) displacement (d) mass
3. Many steady-state errors in control systems arise from nonlinear sources, such as backlash in gears or a motor that will not move unless the input voltage exceeds a threshold. Steady state error depends on type of system also. The type 2 system has ---------- at the origin.
   (C.O.No.2) [Bloom's level: Knowledge]
   (a) No net pole (b) net pole (c) simple pole (d) two poles
4. When the number of poles is equal to the number of zeroes, how many branches of root locus tends towards infinity? (C.O.No.2) [Bloom's level: Knowledge]
   (a) 1 (b) 2 (c) 0 (d) = Poles
5. The most important problem in linear control systems concerns stability. That is, under what conditions will a system become unstable or stable? The roots of the characteristic equation do not have any effect on the stability of the system (C.O.No.2) [Bloom's level: Knowledge]
   (a) True (b) False

6. using the absolute stability necessary condition, identify the stability conditions of the given characteristic equation of a system as $5s^2+2s+3=0$. (C.O.No.2) [Bloom's level: Knowledge]

(a) Stable (b) Marginally stable (c) Unstable (d) Linear

7. In a bode magnitude plot, which one of the following slopes would be exhibited at high frequencies by a 4th order all-pole system? (C.O.No.3) [Bloom's level: Knowledge]

(a) -80dB/decade (b) -40 dB/decade

(c) 40 dB/decade (d) 80 dB/decade

8. The magnitude & phase relationship between _____input and the steady state output is called as Frequency domain. (C.O.No.3) [Bloom's level: Knowledge]

(a) Step (b) Ramp (c) Sinusoidal (d) Parabolic

9. First column elements of the Routh's tabulation are 3, -5, -3/4, ½, 2. It means that there are _____ poles on right half of the S-plane. (C.O.No.2) [Bloom's level: Knowledge]

10. Lead and lag compensators are used quite extensively in control. Compensators are usually designed for a system in transfer function form. A compensator can (C.O.No.4) [Bloom's level: Knowledge]

a. Increase the stability b. reduces the steady state error

c. reduce transient time d. all of the above

Part B [Thought Provoking Questions]

Answer **all** the Questions. **Each** question carries **TEN** marks. (4Qx10M=40M)

11. Integrated circuits are manufactured through a lithographic process on a semiconductor wafer. In lithography, similarly to chemical photography, a semiconductor wafer is covered with a photosensitive emulsion and then selectively exposed to light to form the electronic components. Due to miniaturization, this process is to be performed with nanometer accuracy and at the highest possible speed. Sophisticated apparatus and methods have been developed for this purpose. Figure 1 shows the signal flow graph of block diagram of a scanner dedicated to this purpose (Butler, 2011). Use Mason's gain formula and find the transfer function C(s) / R(s). (C.O.No.1) [Bloom's level: Comprehension]

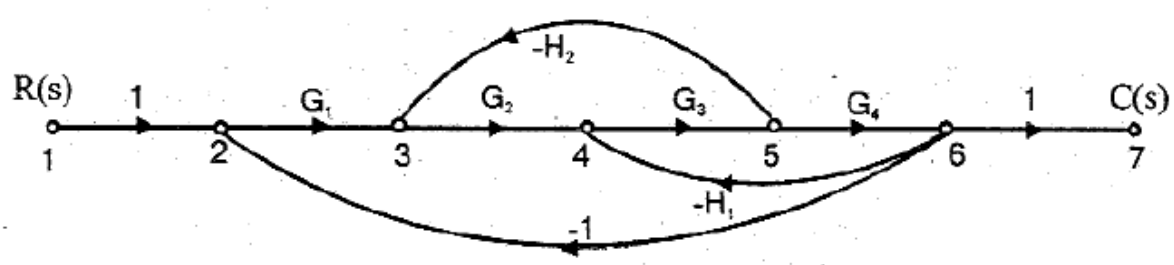

Figure.1

12. An electric ventricular assist device (EVAD) has been designed to help patients with diminished but still functional heart pumping action to work in parallel with the natural heart. The device

consists of a brushless dc electric motor that actuates on a pusher plate. The plate movements help the ejection of blood in systole and sac filling in diastole. System dynamics during systolic mode have been found to be:

$$\dot{X} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U \; ; \; Y = [0 \;\; 1] X$$

The state variables in this model are X which consist of the pusher plate position the pusher plate velocity. The input to the system is U, the motor voltage. Find the transfer function to diagonalize the system. Also verify the Kalman's Test for the system.

(C.O.No.4) [Bloom's level: Comprehension]

13. The A simple method for finding the roots of the characteristic equation has been developed by W. R. Evans and used extensively in control engineering, this method is called root locus. A unity feedback system is defined by the characteristics equation is s^3+6s^2+8s+K =0

(C.O.No.3) [Bloom's level: Comprehension]

14. The stability analysis is done using Routh-Hurwitz criterion and hence the number of roots on the right is calculated. The given characteristic equation s^4+s^3+2s^2+2s+3=0 Verify whether the given system is stable or not. Justify your answer.(C.O.No.2) [Bloom's level: Comprehension]

Part C [Problem Solving Questions]

Answer **all** the Questions. **Each** question carries **TWENTY** marks (2Qx20M=40M)

15. Bode plots are very useful in electronics for determining to stability of op-amps and transistors and is essentially a plot of phase against frequency compared with gain against frequency. Bode plots can also be used to select sensors that you need to use in a given project. For example, while designing a system to perform vibration analysis in a machine it is required to use accelerometer or velocimeter sensor. It turns out a Bode plot is very useful telling you what frequencies the sensor is good at, given the specifications that you have for your project. Use bode plot for the following open loop transfer function.

G(s) = 10 / s(1+0.4s)(1+0.1s)

List different parameters that can be used to define the system stability. Compute the listed parameters and infer the stability of the system using the computed parameters.

(C.O.No.3) [Bloom's level: Application]

16. The principle of argument specifies the relationship between enclosure of poles & zeros by s-plane contour and the encirclement of origin by q(s) plane contour. Using Nyquist plot find the number of encirclements in q(s) plane and asses the closed loop system stability of the following open loop transfer function G(s)H(s) = 20 (s+2)/ (s+3)(s-3) . (C.O.No.3) [Bloom's level: Application]