

**III B.Tech II Semester Supplementary Examinations,  
November/December 2005  
BIOLOGICAL CONTROL SYSTEMS  
(Bio-Medical Engineering)**

**Time: 3 hours****Max Marks: 80**

**Answer any FIVE Questions  
All Questions carry equal marks**

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1. Draw the Signal Flow Graph for a given block diagram and obtain the transfer function? Explain Mason's Gain formula for SFG. What are type 0, 1 & type 2 systems? [16]
2. Draw the time response curve for a second order system for  $0 < \tau < 1$ . Derive the expression for the same. Define rise time, peak overshoot, delay time and peak time. [16]
3. (a) Show that the output of a system to a bounded input is stable if the impulse response is finite.  
(b) Write about the various methods for finding the stability of a system. [8+8]
4. Sketch the Bode plot for the following transfer function and obtain gain and phase margin.  
$$(S) = \frac{10(1+0.5S)}{S(1+0.1S)(1+0.2S)}$$
 [16]
5. Discuss about pupil control system and develop block diagram for the same? [16]
6. Draw the information flow diagram of human thermoregulation system and explain how the temperature is maintained? [16]
7. Explain the respiratory control system with a neat information flow diagram? [16]
8. (a) Write in detail about the human operator models.  
(b) Explain about the human operator tracking characteristics. [8+8]

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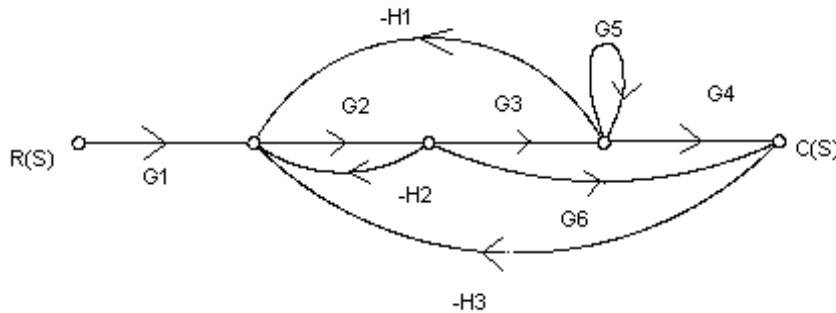
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1. Find the overall gain  $C(S)/R(S)$  for the signal flow graph shown in the below figure.



[16]

2. Draw the time response curve for a second order system for  $0 < \tau < 1$ . Derive the expression for the same. Define rise time, peak overshoot, delay time and peak time. [16]
3. Construct Routh array and determine the stability of the system whose characteristic equation is  $S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$ . Also determine the number of roots lying on right half of S-plane, left half of S-plane and on imaginary axis. [16]
4. Sketch the root locus of the system whose open loop transfer function is  $G(S) = K/(S(S+2)(S+4))$ . Find the value of K so that the damping ratio of the closed loop system is 0.5? [16]
5. (a) Discuss the dynamic and steady state response characteristics of the Pupil control system? [8+8]
- (b) Derive the transfer function of a semi-circular canal. [8+8]
6. Draw the information flow diagram of human thermoregulation system and explain how the temperature is maintained? [16]
7. Explain the respiratory control system with a neat information flow diagram? [16]
8. (a) Explain the terms Adaptation and Rate Sensitivity.

- (b) Obtain the transfer function of the Mechano-receptor due to Chapman & Smith.  
hfill[8+8]

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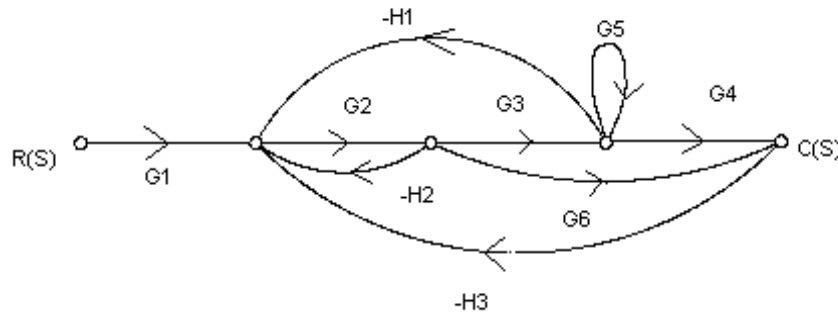
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1. Find the overall gain  $C(S)/R(S)$  for the signal flow graph shown in the below figure.



[16]

2. (a) The forward transfer function of a unity feedback type-I, second order system has a pole at -2. The nature of gain  $K$  is so adjusted that damping ratio is 0.4. The above equation is subjected to input  $r(t) = 1 + 4t$ . Find the steady state error.
- (b) Define static error coefficients,  $k_v$ ,  $k_a$  and  $k_p$ . Explain how the steady state error can be computed using the error coefficients. [16]
3. (a) Show that the output of a system to a bounded input is stable if the impulse response is finite.
- (b) Write about the various methods for finding the stability of a system. [8+8]
4. Sketch the root locus of the system whose open loop transfer function is  $G(S) = K/(S(S+2)(S+4))$ . Find the value of  $K$  so that the damping ratio of the closed loop system is 0.5? [16]
5. (a) Discuss the dynamic and steady state response characteristics of the Pupil control system?
- (b) Derive the transfer function of a semi-circular canal. [8+8]
6. Draw the information flow diagram of human thermoregulation system and explain how the temperature is maintained? [16]
7. Explain the respiratory control system with a neat information flow diagram? [16]

8. Discuss about the various receptor characteristics and their transfer functions.  
Name some receptors and their functions. [16]

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1. Differentiate between the following types of technological control systems with examples:
  - (a) Open loop and Closed loop systems.
  - (b) A Regulator and a Servomechanism. [8+8]
2. (a) Define various time domain and frequency domain specifications?  
(b) Distinguish between Proportional and Proportional plus Derivative control. [8+8]
3. (a) Show that the output of a system to a bounded input is stable if the impulse response is finite.  
(b) Write about the various methods for finding the stability of a system. [8+8]
4. Sketch the root locus of the system whose open loop transfer function is  $G(S) = K/(S(S + 2)(S + 4))$ . Find the value of K so that the damping ratio of the closed loop system is 0.5? [16]
5. Discuss about pupil control system and develop block diagram for the same? [16]
6. Draw the information flow diagram of human thermoregulation system and explain how the temperature is maintained? [16]
7. (a) Explain the cardio vascular control system.  
(b) Explain various feedbacks that are present in the Visual Fixation system? [8+8]
8. (a) Write in detail about the human operator models.  
(b) Explain about the human operator tracking characteristics. [8+8]

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