

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-V • EXAMINATION – WINTER • 2014

Subject Code: 150304

Date: 08-12-2014

Subject Name: Modeling and Simulation of Biological Systems

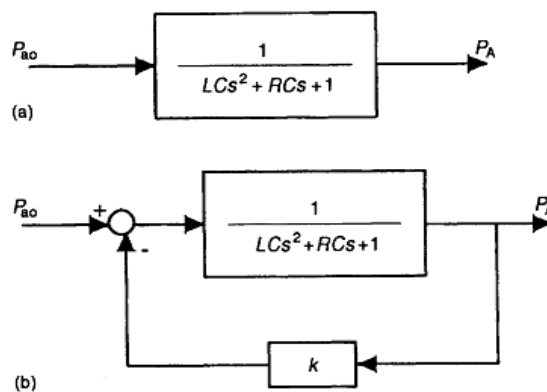
Time: 10:30 pm to 01:00 pm

Total Marks: 70

Instructions:

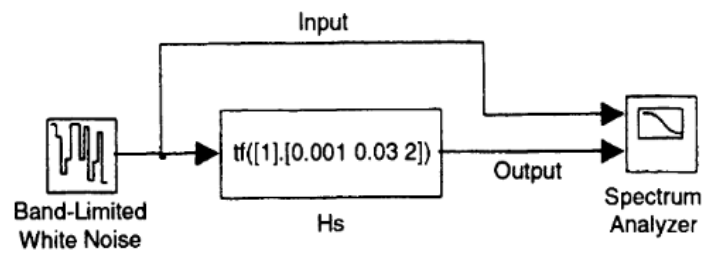
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the purpose of modeling of a physiological system with applications in real world. **07**
- (b) Give a difference between linear and non-linear model with appropriate example of physiological systems. **07**
- Q.2** (a) Discuss the effects on pressure at airway opening and air volume flow rate with increase in respiration rate. **07**
- (b) Explain the muscle stretch reflex action and draw the physiological model of muscle stretch reflex system. **07**
- OR**
- (b) Explain the procedure to determine the steady-state operating point of any physiological system. **07**
- Q.3** (a) Enlist the methods of system analysis and explain the process of identification of a close-loop system. **07**
- (b) What is agonist & antagonist neurological control signals? **07**
- OR**
- Q.3** (a) Describe the stability in terms of physiological systems with necessary examples. **07**
- (b) Draw & explain westheimer's saccadic eye movement model with it's limitations. **07**
- Q.4** (a) Draw and explain the computational flow diagram of cardiac system. **07**
- (b) Draw the frequency responses of the systems shown in Figure, when: **07**
- (a) The feedback loop is open
- (b) The feedback loop is closed.
- (Assume the time delay $T=1\text{sec}$)



OR

- Q.4** (a) Describe the viscoelasticity of lung muscles. Draw a model of lung tissue viscoelastance. 07
- (b) Determine the frequency response of linearized lung mechanics model as shown in figure. 07



- Q.5** (a) Draw and explain frequency responses of the circulatory control model of normal heart rate control with effects of vasodilator and vasoconstrictor. 07
- (b) Draw steady-state analysis of glucose regulation in normal conditions & diabetic patient. Also derive a mathematical function to estimate the steady-state glucose and insulin levels in a patient with an abnormally high gain in the insulin response to glucose. (Assume β to be twice as large as its normal value.) 07

OR

- Q.5** (a) Draw and explain the frequency responses of glucose-insulin regulation model in conditions simulating a typical normal human and a Type-2 diabetic. 07
- (b) Develop the mechanical equivalent of the electrical analog of respiratory mechanics shown in figure. 07

