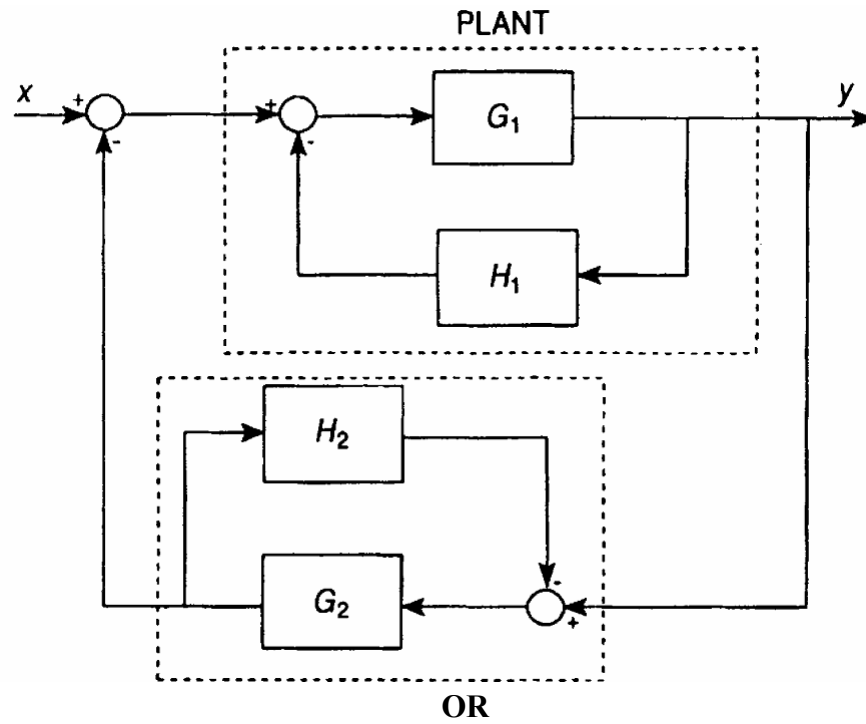


GUJARAT TECHNOLOGICAL UNIVERSITY**BE SEM-V Examination-Nov/Dec.-2011****Subject code: 150304****Date: 03/12/2011****Subject Name: Modeling & Simulation of Biological Systems****Time: 2.30 pm -5.00 pm****Total marks: 70****Instructions:**

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

- Q.1** (a) Explain the difference between Engineering & Physiological Control System with necessary examples. **07**
- (b) Define Starling's law. Also draw & explain the cardiac output and venous return curves. **07**
- Q.2** (a) Explain how to determine steady-state operating point with block diagrams. **07**
- (b) Briefly explain Distributed Parameter Versus Lumped Parameter. **07**
- OR**
- (b) Derive the equations which govern the model of heart & systemic circulations. **07**
- Q.3** (a) Describe the chemical regulation of ventilation with neat diagrams. **07**
- (b) Draw SIMULINK model of neuromuscular reflex model. **04**
- (c) Explain the equilibrium point for muscle stretch reflex. **03**
- OR**
- Q.3** (a) Describe open-loop & closed-loop transient responses for first order model. **07**
- (b) Draw & explain the curves of Cardiac Output & Venous Return for below given conditions. **04**
1. Normal
2. Moderate Exercise
3. Heart Failure
- (c) Explain the effects of respiratory system on HR & Systemic blood pressure. **03**
- Q.4** (a) Draw the simplified model of cardiac output regulation. **07**
- (b) Draw & explain Westheimer's saccadic eye movement model. **07**
- OR**
- Q.4** (a) Draw the SIMULINK model of simple lung mechanics. **07**
- (b) Explain Robinson's model with agonist & antagonist neurological control signal. **07**
- Q.5** (a) Draw the plots for saccade characteristics. **04**
- (b) Below given figure shows the block diagram of a sophisticated biomedical device for regulating the dosage of anesthetic gases being delivered to a patient during surgery. Note that the plant and controller are themselves feedback control systems. **10**
- (a) Derive an expression for the open-loop gain of the overall control system.
- (b) Derive an expression for the closed-loop gain of the overall control system.
- (c) If $G_1 = 1$, $G_2 = 2$, $H_1 = 1$, and $H_2 = 2$, what is the loop-gain of the overall system?



Q.5 (a) Describe the below given terms for lung mechanics with equation. **04**

1. P_A
2. P_{ao}
3. P_o
4. Q

(b) Develop the electrical analog of the muscle mechanics model shown in below **10**
Figure.

