Date: 02-12-2014

Total Marks: 70

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

Subject Code: 170302

Subject Name: Physiological System Modeling

Time: 10:30 am - 01:00 pm

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Give a difference between static and dynamic analysis of physiological systems. 07
 - (b) Draw and explain distributed and lumped SIMULINK model of simple lung 07 mechanics.
- Q.2 (a) Explain the requirement of modeling of physiological systems with appropriate 07 examples.
 - (b) Draw and explain linear model of respiratory mechanics with necessary 07 equations.

OR

- (b) Draw and explain linear model of muscle mechanics with necessary equations. 07
- Q.3 (a) Derive the equilibrium point for muscle stretch reflex model with nonlinear 07 characteristics.
 - (b) Draw and explain the simplified model of cardiac output regulation with cardiac 07 output and venous return curves.

OR

- Q.3 (a) Draw and explain steady-state closed-loop analysis of cardiac output regulation 07 during
 - A. Normal resting conditions
 - B. Moderate exercise and
 - C. Compensated heart failure
 - (b) Briefly describe the frequency response of glucose-insulin model with necessary 07 graphs.
- Q.4 (a) Write short notes on 07
 - (a) Oculomotor muscle model
 - (b) Linear muscle model
 - (b) Draw the SIMULINK model of respiratory sinus arrhythmia with required 07 graphs.

OR

- Q.4 (a) Write the methods of system analysis and describe the process of identification 07 of a close-loop system.
 - (b) Explain the westheimer's saccadic eye movement model and derive equations for 07 peak overshoot and peak velocity.
- Q.5 (a) Draw and explain the frequency responses of glucose-insulin model with 07 necessary graphs.
 - (b) Define stability of any one physiological system. Explain the criteria for stability 07 analysis.

Q.5 (a) Suggest and justify a system analysis technique for a close-loop system with 04 below given frequency response.



- (b) Below 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.
 - 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?


