

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – SUMMER • 2014****Subject Code: 150304****Date: 24-06-2014****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) Briefly describe the results of simple lung mechanics model for 15 & 60 breaths /min with neat sketch. What effects does the model depicts while increasing the frequency of respiration ventilator? **07**
- (b) Describe the Closed-Loop Analysis of Lungs and Controller Combined. **07**
- Q.2** (a) Briefly explain the gas exchanger model with appropriate equations. **07**
- (b) Give difference: Distributed Parameter versus Lumped Parameter. **07**

OR

- (b) Give difference: Engineering & Physiological Control System **07**
- Q.3** (a) Draw a velocity vs. time graph for 10° saccade. Label and explain below given terminologies. **07**
1. Saccade Duration
 2. Latent Period
 3. Saccade magnitude
 4. Peak Velocity
 5. Time at peak velocity
- (b) Draw the plots and explain the Closed-Loop Analysis of Heart and Systemic Circulation Combined. **07**

OR

- Q.3** (a) Derive the equations for time to peak overshoot (t_p) & time at peak velocity (t_{mv}) from westheimer's saccadic eye model. **07**
- (b) Draw and explain the steady-state analysis of glucose regulation under **07**
- a) Normal conditions
 - b) Type-I diabetes
 - c) Type-II diabetes
- Q.4** (a) Draw the simplified model of cardiac output regulation and derive mathematical expressions for the model. **07**
- (b) Draw and explain the graphical representation of steady-state operating point. **07**

OR

- Q.4** (a) Explain nonlinearity in model with appropriate examples. **07**
- (b) Explain neuromuscular reflex model with neat sketch. **07**
- Q.5** (a) Describe the difference between static and dynamic analysis with appropriate examples. **07**
- (b) Draw and explain the frequency responses of glucose-insulin regulation model in conditions simulating a typical normal human and a Type-2 diabetic. **07**

OR

- Q.5** (a) Derive the Relationship between Transient and Frequency Responses. **07**
- (b) Draw and explain the graphical analysis of the steady-state regulation of ventilation during **07**
- (a) normoxia ($PIO_2 = 150\text{mm Hg}$) and
 - (b) exposure to mild hypoxia through ascent to altitude.
