Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2150305 **Date: 01/05/2017**

Subject Name: Modelling & Simulation of Physiological systems

Time: 02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

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

MARKS

Q.1 Short Questions. **14**

1 In an open-loop linearized respiratory mechanics model..

A Output is independent of control input B Output is dependent of control input

C Only model parameters have effect on the control output D None of the above

2 In closed loop control system, with increase in positive value of feedback gain the overall gain of the system will

A increase B be unaffected

C decrease D any of the above

3 Different physiological control systems

A does not rely on inputs from each other B are isolated from each other

C depends only on output of cerebral cortex of brain D have extensive degree of cross-coupling

4 A muscle stretch leads to an _____ in _____ neural traffic.

A Decrease, afferent B Increase, both afferent and efferent

C Increase, efferent D Decrease, overall

5 How is negative feedback achieved in muscle stretch reflex?

A A signal from higher centers of brain controls feedback action B Feedback is modified according to the inter neuron connections

C Feedback is embedded in plant characteristics D None of the above

6 With increase in ventilator frequency of lung mechanics model

A Flow rate will increase B Tidal volume will increase

C Tidal volume will decrease D Graphs of Pao and Q are out of phase

7 In the muscle stretch reflex model, with increase in efferent neural frequency muscle length will

A increased B decreased

C unchanged D Stay at steady-state

8 _____ is a part of the human temperature control system.

A Digestive system B Perspiration system

C Ear D Leg movement

9 signal will become zero when the feedback signal and reference signs are equal.

A Input B Actuating

C Feedback D Reference

10 In neuro-muscular reflex model, with _____ feedback gain (β) the response tends to overdamped.

A large B small

C Zero D Unity

11 In respiratory sinus arrhythmia model, with increase in heart rate and lung volume, the cardiac output will _____.

A Increase B Decrease

C Constant D Become infinite

12 Under "purely vagal" state, the phase difference between respiration and heart rate is

A large B zero

C small D infinite

13 Which of the following is not a fundamental problem of physiological system analysis?

A Prediction B Identification

C Diagnosis D Normalization

14 The level of oxygenation affects the blood CO2 concentration at any given partial pressure. This effect is known as

A Haldane effect B Bohr effect

C Starling effect D Stolwijk effect

Q.2 **(a)** Define agonist and antagonist oculo-muscle movements. **03**

(b) Explain experimental setup of robinson's model. **04**

(c) Derive the mathematical formula for magnitude and phase for linearized respiratory mechanics model (open-loop case). **07**

OR

(c) Explain steady-state model of the chemical regulation of ventilation with mathematical formulas. **07**

Q.3 **(a)** Define the saccade characteristics. **03**

(b) Draw and explain cardiac output curves for various factors. **04**

(c) Draw and explain the steady-state characteristics of the baroreftex. (both cardiac period and stroke volume are assumed to be dependent on arterial blood pressure) **07**

OR

Q.3 **(a)** Explain system variables and properties of Resistance & Compliance. **03**

(b) Draw and explain venous return curves for various factors. **04**

(c) Draw and explain the time and frequency domain response of the glucose-insulin regulation model to a rapid (15 min) infusion of 25g of glucose in a simulated normal human and a Type-2 diabetic patient. **07**

Q.4 **(a)** Draw the time-courses of ionic conductances and membrane potential during an action potential. **03**

(b) Draw equivalent circuit of Hodgkin-Huxley model with illustrations. **04**

(c) Explain the dynamic version of Stolwijk and Hardy model for glucose insulin regulation. **07**

OR

Q.4 **(a)** Draw the mechanical model of muscle mechanics that includes the effect of muscle mass. **03**

(b) Analyze the results of lung mechanics model for 15 & 60 breaths/min. **04**

(c) Explain the SIMULINK model of respiratory sinus arrhythmia. **07**

Q.5 **(a)** Draw the frequency responses and bode plot of the linearized lung mechanics model for both open-loop and close-loop modes. **03**

(b) Determine equilibrium point for muscle stretch reflex model with nonlinear characteristics. **04**

(c) Draw and explain the cardiovascular variability model with single feedback loop. **07**

OR

Q.5 **(a)** Give differences of lumped & distributed models. **03**

(b) Draw the frequency responses of the circulatory control model under below given conditions. **04**

1. Normal heart rate control
2. Complete β-adrenergic blockade
3. Complete parasympathetic blockade

(c) Draw and explain the cardiovascular variability model with two interacting feedback loops. **07**

****