

**GANPAT UNIVERSITY**

**B. Tech. Semester: V (Biomedical & Instrumentation) Engineering**

**CBCS Regular Examination November – December 2014**

**2BM501 Physiological Control Systems & Modeling**

**Time: 3 Hours**

**Total Marks: 70**

- Instruction:**
1. Write each section in separate answer book.
  2. Figures to the right indicate marks.
  3. Assume suitable data, if necessary.
  4. Answer should be brief and to the point.

**Section – I**

**Que. – 1**

- a) What is extensive degree of cross coupling among different physiological control system? Draw and explain by using example.
- b) Draw and explain the resistive and capacitive property for mechanical and fluidic system. Compare it with Ohm's law.

**12**

**OR**

**Que. – 1**

- a) Explain how physiological control systems are adaptive. Draw the functional block diagram of it.
- b) Draw the models of parallel and series combinations of mechanical dashpots for resistances and springs for compliances along with mathematical expression.

**12**

**Que. – 2**

- a) Define 'cardiac output'. Draw and explain the simplified model of cardiac output regulation.
- b) Draw and explain linear model of skeletal muscle. Also derive its mathematical equation.

**11**

**OR**

**Que. – 2**

- a) Draw and explain venous return curve.
- b) Draw the steady state model of the chemical regulation of ventilation and CO<sub>2</sub> exchange in the lungs. Explain and derive the equations of it.

**11**

**Que. – 3**

- a) Draw the block diagram displaying the steady state characteristics of the muscle stretch reflex model components and explain the procedure for determination of steady state operation point.
- b) Enlist three major ways through which glucose is eliminated from blood. Draw the schematic representation of the process involved in the regulation of glucose and insulin and explain in detail.

**12**

Section – II

Que. – 4

- 12
- What is the requirement of standard test signals? Explain the different types of standard test signals used to analyze the time response of a control system.
  - Derive the linear electrical model of respiratory mechanics. Also derive the transfer function of the system and represent it in open loop and closed loop configuration.

OR

Que. – 4

- 12
- What is the significance of time response analysis of control system? List out the steps to perform the time response analysis of the physiological control systems.
  - Draw and explain the time response of second order system subjected to unit impulse input.

Que. – 5

- 11
- For the linear lung mechanics model with integral feedback (k/s), determine the conditions which must be satisfied by the co-efficient of the characteristics equation for the system to be stable.
  - What are the methods to identify the stability of linear physiological control systems? Explain the significance of each method.

OR

Que. – 5

- 11
- Explain the procedure to sketch the Root locus plot with the help of suitable example.
  - What is the significance of Polar plot? Explain the procedure to sketch the polar plot.

Que. – 6

- 12
- What is Bode plot? Sketch the Bode plot for the linear Lung mechanics model with the following parameters.

$$T.F = \frac{10}{LCs^2 + RCs + 1}$$

Where  $L = 0.0001 \text{ cmH}_2\text{Os}^2$ ,  $R = 0.101 \text{ cmH}_2\text{Os L}^{-1}$   $c = 1 \text{ LcmH}_2\text{O}^{-1}$

- What is Gain cross-over frequency and Phase cross-over frequency in Bode plot? How it will effect on the stability of the system.

END OF PAPER