SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

VII SEMESTER

1910701- PHYSIOLOGICAL MODELLING

Regulation – 2019

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Prepared by

Dr. P. Vanmathi, Assistant Professor/MDE

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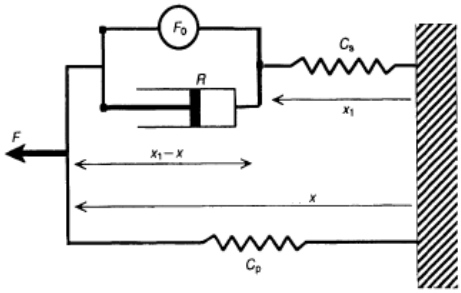
DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

SUBJECT : 1910701 - PHYSIOLOGICAL MODELLING

SEM / YEAR : VII / IV

	UNIT – I: INTRODUCTION TO PHYSIOLOGICAL MODELLING			
	Approaches to modelling: The technique of mathematical modelling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modelling. Introduction to physiology (homeostasis, cell biology) Modelling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.			
	PART – A			
Sl.No.	**Questions**	**CO**	**BT Level**	**Competence**
1.	What is meant by physiological modelling?	CO1	BTL 1	Remembering
2.	Write the need of physiological Modelling.	CO1	BTL 2	Understanding
3.	Outline the physiological models in Biopharmaceutics.	CO1	BTL 1	Remembering
4.	What are the steps of modelling process?	CO1	BTL 1	Remembering
5.	Label the four physiological processes.	CO1	BTL 1	Remembering
6.	Identify the 4 steps of the mathematical modelling process.	CO1	BTL 2	Understanding
7.	Interpret the need for mathematical modelling of a physiological system.	CO1	BTL 2	Understanding
8.	Point out the mathematics in human physiology.	CO1	BTL 2	Understanding
9.	How is the mathematics related to the human body?	CO1	BTL 2	Understanding
10.	Specify the classification of mathematical model of physiological systems.	CO1	BTL 1	Remembering
11.	List the major function of physiological system.	CO1	BTL 1	Remembering
12.	Mention the terms in physiological modelling.	CO1	BTL 2	Understanding
13.	Sketch the open-loop control system and a closed-loop system.	CO1	BTL 1	Remembering
14.	Express the muscle stretch reflex negative feedback system.	CO1	BTL 2	Understanding
15.	Differentiate between engineering and physiological control systems.	CO1	BTL 2	Understanding
16.	Outline the time invariant and time varying system.	CO1	BTL 2	Understanding
17.	What is the physiological process of homeostasis?	CO1	BTL 1	Remembering
18.	State the cell homeostasis in biology.	CO1	BTL 1	Remembering
19.	Write the relationship between insulin resistance and hyperinsulinemia?	CO1	BTL 1	Remembering
20.	List the three interdependent components of homeostatic control mechanisms.	CO1	BTL 1	Remembering

21.	Name the cells transport materials.		CO1	BTL 1	Remembering
22.	How do cells interact with their environment?		CO1	BTL 2	Understanding
23.	What are the basic elements of the classical cell?		CO1	BTL 1	Remembering
24.	Write the different between distributed-parameter versus lumped-parameter Models		CO1	BTL 2	Understanding
	PART – B				
1.	Briefly explain the description of the actions involved in Energy Homeostasis.	(13)	CO1	BTL 4	Analysing
2.	Explain the intrinsic, extrinsic factors of homeostatic control mechanisms model of physical systems.	(13)	CO1	BTL 3	Applying
3.	Why most of the homeostatic processes use negative feedback regulation, explain with suitable diagram.	(13)	CO1	BTL 4	Analysing
4.	Describe the positive feedback mechanism of the blood clotting cascade homeostatic processes.	(13)	CO1	BTL 3	Applying
5.	Calculate the number of moles of sodium hydroxide (NaOH) needed to make 2.50 L of 0.100 M NaOH.	(13)	CO1	BTL 3	Applying
6.	Explain the linear model of respiratory system and derive the mathematical model with necessary steps.	(13)	CO1	BTL 4	Analysing
7.	Explain the distributed-parameter model of physiological systems with an example.	(13)	CO1	BTL 3	Applying
8.	Describe the mechanical equivalent of the electrical circuit of muscle mechanics with necessary diagrams.	(13)	CO1	BTL 4	Analysing
9.	Explain the time varying systems for physiological modelling with necessary illustrations.	(13)	CO1	BTL 4	Analysing
10.	Write the equation of electrical analog equivalent of the given mechanics model shown in Figure. 	(13)	CO1	BTL 4	Analysing
11.	Derive the expression of steady-state response linear physiological system.	(13)	CO1	BTL 3	Applying
12.	Find the system function of given transfer function equation. $$Y(s) = \frac{0.5s + 1.25}{s(s+1)(0.25s+1)}$$	(13)	CO1	BTL 4	Analysing
13.	Explain time invariant systems for physiological modelling with suitable example.	(13)	CO1	BTL 3	Applying
14.	Derive the physiology homeostasis modelling with physical systems and draw the mathematical representation.	(13)	CO1	BTL 4	Analysing
15.	Describe the physiology of cell biology modelling physical systems with necessary diagrams.	(13)	CO1	BTL 3	Applying
16.	Write short notes on the following:		CO1	BTL 3	Applying

	a). Classification of physiological models b). Mathematical modelling of physiological systems.	(7) (6)			
17.	Explain with suitable equation, a). Linear models of physiological systems, b). the Laplace transforms.	 (7) (6)	CO1	BTL 3	Applying
	PART – C				
1.	Derive the Laplace and transfer function of the Linear differential equation: $a_2 \frac{d^2y}{dt} + a_1 \frac{dy}{dt} + y = b_2 \frac{d^2x}{dt} + b_1 \frac{dx}{dt} + b_0x$	(15)	CO1	BTL 4	Analysing
2.	Examine the linear models of two Physiological systems with neat diagrams.	(15)	CO1	BTL 4	Analysing
3.	Write in detail about Physiology of Homeostasis with suitable example.	(15)	CO1	BTL 3	Applying
4.	Describe the characteristics of physiological models with mathematical expression.	(15)	CO1	BTL 4	Analysing
5.	Explain the time invariant systems for physiological modelling with suitable example.	(15)	CO1	BTL 3	Applying

	UNIT – II: MODELLING OF DYNAMIC PHYSIOLOGICAL SYSTEM			
	Dynamic systems and their control, modelling and block diagrams, the pupil control systems (Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.			
	PART – A			
Sl.No.	**Questions**	**CO**	**BT Level**	**Competence**
1.	What do you mean by dynamic system?	CO2	BTL 1	Remembering
2.	Categorize the different type of dynamic systems.	CO2	BTL 2	Understanding
3.	Which of the following is a dynamic system? a). y(t) = x(2t), b). y(t) = x(t) - x(t-1)	CO2	BTL 2	Understanding
4.	Write the characteristics of system behaviour in dynamic system.	CO2	BTL 2	Understanding
5.	Draw the structural representation of dynamic system.	CO2	BTL 2	Understanding
6.	Sketch the feedback control system configuration.	CO2	BTL 1	Remembering
7.	What is active control configuration system?	CO2	BTL 1	Remembering
8.	List the different between active and passive feedback control systems.	CO2	BTL 2	Understanding
9.	Mention the characteristics of man-machine systems.	CO2	BTL 2	Understanding
10.	Draw the information flow diagram of mathematical model of systems.	CO2	BTL 1	Remembering
11.	Define Stability of closed loop control system.	CO2	BTL 1	Remembering
12.	What is the voltage level of electrophysiological signals?	CO2	BTL 1	Remembering
13.	Why we need amplifier in electrophysiological system?	CO2	BTL 2	Understanding
14.	Write the equation of dynamic system transfer function.	CO2	BTL 1	Remembering
15.	Draw the diagram of active controlled configuration of information flow in blood?	CO2	BTL 1	Remembering

16.	Write the equivalent comparator action of nonlinearity of pupil control system.		CO2	BTL 2	Understanding
17.	Outline the dynamic system behaviour.		CO2	BTL 1	Remembering
18.	Define automatic aperture control.		CO2	BTL 1	Remembering
19.	State the weber Fechner law.		CO2	BTL 1	Remembering
20.	Which device is used for the feed backed measuring device?		CO2	BTL 2	Understanding
21.	What is the open loop gain?		CO2	BTL 1	Remembering
22.	Why transfer function (H) of closed loop system is -1?		CO2	BTL 2	Understanding
23.	Define feed forward of aperture control.		CO2	BTL 1	Remembering
24.	Outline the half cycle delay in terms of pupil control.		CO2	BTL 2	Understanding
	PART – B				
1.	Describe the following in terms of dynamic system, a). Pupil control systems, b). Feedback control systems configuration.	 (7) (6)	CO2	BTL 3	Applying
2.	Derive the weber Fechner law of retinal block of pupil control system and explain.	(13)	CO2	BTL 4	Analysing
3.	Explain the generic structure of control system with an example.	(13)	CO2	BTL 4	Analysing
4.	a) What is instability of closed loop? b) Explain the instability of closed loop with suitable block diagram.	(3) (10)	CO2	BTL 3	Applying
5.	Derive the expression for loop gain “K” of closed-loop system with necessary diagrams.	(13)	CO2	BTL 3	Applying
6.	Describe the information flow of dynamic in terms of man machine using speed control of car.	(13)	CO2	BTL 3	Applying
7.	How the quantitative analysis is to make the mathematical models?	(13)	CO2	BTL 4	Analysing
8.	Explain the Pupil control system with suitable block diagram.	(13)	CO2	BTL 3	Applying
9.	In pupil control systems, how the information is flow from brain cell? Explain with suitable dynamic system.	(13)	CO2	BTL 3	Applying
10.	a). Distinguish between servomechanism and regulator. b). Explain with generic structure of control systems.	(7) (6)	CO2	BTL 3	Applying
11.	Examine about automatic aperture control analog pupil system.	(13)	CO2	BTL 3	Applying
12.	Illustrate function of automatic control of camera aperture.	(13)	CO2	BTL 3	Applying
13.	Examine the instability of closed loop negative feedback systems of pupil system with necessary diagrams.	(13)	CO2	BTL 4	Analysing
14.	Point out following in terms of open and closed loop dynamic systems, a). Generalised open and closed loop model. b). Instability of closed loop systems.	 (6) (7)	CO2	BTL 3	Applying
15.	Outline the dynamic response characteristics of the pupil control system, a). Steady state response, b). Dynamic response.	 (6) (7)	CO2	BTL 3	Applying
16.	Express the function of energy definition of dynamic system component.	(13)	CO2	BTL 4	Analysing

17.	Describe the impulse and steady state response of control system with necessary diagrams.	(13)	CO2	BTL 3	Applying
	PART – C				
1.	Explain the following characteristics of pupil control system, a). Steady state response. b). Dynamic response.	 (7) (8)	CO2	BTL 4	Analysing
2.	Write short note on following, a). Open Loop control system b). Dynamic system, c). Closed Loop Control system.	 (5) (5) (5)	CO2	BTL 3	Applying
3.	How the negative feedback subtracted from input of active and passive dynamic control system? Justify the output of the system with suitable block diagram representation.	(15)	CO2	BTL 4	Analysing
4.	Explain in detail about instability of open and closed loop control system with necessary diagrams.	(15)	CO2	BTL 3	Applying
5.	Explain the following in terms of dynamic system control system: a). Retinal block – comparator b). Retinal block – logarithmic sensitivity c). Retinal block – adaptation dynamics.	 (5) (5) (5)	CO2	BTL 3	Applying

	UNIT – III: NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS			
	Nonparametric Modelling -Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modelling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.			
	PART – A			
Sl.No.	**Questions**	**CO**	**BT Level**	**Competence**
1.	Compare between Volterra and wiener nonlinear model.	CO3	BTL 2	Understanding
2.	What is a wiener class system?	CO3	BTL 1	Remembering
3.	What are the limitations of wiener kernels?	CO3	BTL 1	Remembering
4.	Write the difference between Volterra model predication and wiener model predication.	CO3	BTL 1	Remembering
5.	Write the equation of first order Volterra model mean square error?	CO3	BTL 1	Remembering
6.	What is the structure of skin multivariate hermite polynomials?	CO3	BTL 1	Remembering
7.	Write the reason for wiener MIT. Why cannot be apply practically physiological system?	CO3	BTL 2	Understanding
8.	Draw the block diagram of wiener nonlinear model.	CO3	BTL 2	Understanding
9.	What is the m^{th}-order output residual cross-correlation wiener kernel?	CO3	BTL 1	Remembering
10.	Write the predication error of wiener kernel?	CO3	BTL 2	Understanding

11.	List the advantage and disadvantage of PRS.		CO3	BTL 2	Understanding
12.	Write the equation of Non-white Gaussian inputs apparent transfer function?		CO3	BTL 2	Understanding
13.	What you mean by duffing systems in apparent transfer function?		CO3	BTL 2	Understanding
14.	List the efficiency of Volterra kernel estimation.		CO3	BTL 1	Remembering
15.	What are the limitations of cross-correlation techniques?		CO3	BTL 2	Understanding
16.	Outline the optimized input parameter estimation error.		CO3	BTL 1	Remembering
17.	What is nonparametric learning?		CO3	BTL 1	Remembering
18.	What are the nonparametric statistics models?		CO3	BTL 2	Understanding
19.	What is the basic equation for the prey prediction in the Lotka-Volterra model?		CO3	BTL 2	Understanding
20.	What is the difference between parametric and nonparametric method?		CO3	BTL 2	Understanding
21.	State Volterra principle.		CO3	BTL 1	Remembering
22.	Why a system is called stationary system?		CO3	BTL 2	Understanding
23.	Write the mathematical equation of function of line.		CO3	BTL 2	Understanding
24.	When the system is dynamic nonlinearity.		CO3	BTL 1	Remembering
	PART – B				
1.	Distinguish the relation between Volterra and wiener nonlinear model in terms of time and frequency.	(13)	CO3	BTL 3	Applying
2.	Categorize the functionality of following nonlinear models, a). Wiener class systems, b). Volterra model predication.	 (7) (6)	CO3	BTL 3	Applying
3.	How is the static nonlinear system having no formal equivalent Wiener model, Explain in detail.	(13)	CO3	BTL 4	Analysing
4.	Illustrate the following nonlinear model system, a). Relation between volterra and wiener models. b). Wiener Approach to Kernel Estimation.	 (7) (6)	CO3	BTL 3	Applying
5.	Explain the Cross-Correlation techniques for Wiener Kernel Estimation.	(13)	CO3	BTL 3	Applying
6.	Illustrate the application of the cross-correlation technique on a real system.	(13)	CO3	BTL 3	Applying
7.	What is the relation between CSRS and Volterra kernel? Explain with an analytical example.	(13)	CO3	BTL 3	Applying
8.	Explain the following measurement of nonlinear systems, a). Apparent transfer function and coherence measurement, b). What are the remarks of apparent transfer function?	 (7) (6)	CO3	BTL 4	Analysing
9.	Write a short notes on the following, a). Model order detection, b). Effective Volterra kernel estimation.	 (7) (6)	CO3	BTL 3	Applying
10.	Analysis about the high-order volterra modelling with equivalent networks of nonparametric modelling.	(13)	CO3	BTL 4	Analysing
11.	a) What are source estimation errors? b) Explain the Estimation Errors associated with the Cross-Correlation Technique of nonparametric	(3) (10)	CO3	BTL 3	Applying

	modelling.				
12.	How the estimation error is associated direct inversion and Iterative Cost-Minimization method? Explain with suitable equation.	(13)	CO3	BTL 3	Applying
13.	Describe the nonlinear input and output relation, and explain with basic parametric estimation process.	(13)	CO3	BTL 4	Analysing
14.	Write the mathematical relation between the Riccati equation and the Volterra functional expansion of nonlinear differential equations using volter kernel?	(13)	CO3	BTL 3	Applying
15.	Summaries the application of volterra kernels of nonlinear differential equations and give the analytical example of Riccati Equation volterra kernels.	(13)	CO3	BTL 3	Applying
16.	Consider the differential equation model has a single square nonlinearity is $D^2y + 2a_1Dy + a_0Y - cy^2 = bx$, find the NARMAX model of the nonlinear?	(13)	CO3	BTL 3	Applying
17.	Describe the following nonlinear models, a). Volterra Models, b). Wiener Models	 (6) (7)	CO3	BTL 4	Analysing
	PART – C				
1.	Explain the following estimation in terms of nonlinear systems , a). Estimation Variance, b). Noise Effects, c). Scaling of Kernel Estimates.	 (5) (5) (5)	CO3	BTL 3	Applying
2.	Describe the following in terms of volterra kernels of nonlinear differential equations a). Apparent Transfer Functions of Linearized Models b). Nonlinear Parametrie Models with Intermodulation	 (7) (8)	CO3	BTL 4	Analysing
3.	In discrete-time impulse response function h(n) is described by the difference equation $h(n) = 0.3h(n - 1) - 0.02h(n - 2) + \delta(n)$, find the z-domain transfer function and s-domain transfer function?	(15)	CO3	BTL 3	Applying
4.	For two dimensional discrete-time system output is $y(n) = 0.5y(n - 1) - 0.3y(n - 2) + O.2x(n)y(n - 1) + 0.4x(n)$, find the system function in terms of z-domain, output is additive noise?	(15)	CO3	BTL 3	Applying
5.	For the nonlinear model system class is described by the differential equation $(a_2D^2 + a_1D + a_0)y + C_{3,0}Y^3 + C_{2,1}y^2(Dy)^2 + C_{3,2}y^3(Dy)^2 + C_{O,5}(Dy)^5 = b_0X$ the coefficients are $a_1 = 2$, $a_1 = 3$, $a_2 = 1$, $b_0 = 1$, $C_{3,0} = 1/12$, $C_{2,1} = 1/12$, $C_{3,2} = -1/12$, and $c_{0.5} = 1/10$, which yield $Q_{1,O} = 1/12$, $Q_{2,1} = 1/36$, $Q_{2,2} = 1/36$. Find the value of A (P) and B (P)?	(15)	CO3	BTL 4	Analysing

	UNIT – IV: COMPARTMENTENTAL PHYSIOLOGICAL MODE				
	Modelling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modelling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical Modelling of the system: Thermo regulation, Thermoregulation of cold bloodedness & warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.				
	PART – A				
Sl.No.	**Questions**		**CO**	**BT Level**	**Competence**
1.	What is the mathematical model of system?		CO4	BTL 1	Remembering
2.	Identify the use of the mathematical model of system.		CO4	BTL 2	Understanding
3.	Point out the drawback of dynamic systems.		CO4	BTL 1	Remembering
4.	Express the two approach of modelling comprises		CO4	BTL 2	Understanding
5.	Write down the transfer characteristics of sensory neural receptors.		CO4	BTL 2	Understanding
6.	Relate the control process of physical modelling.		CO4	BTL 1	Remembering
7.	Define active control system of modelling.		CO4	BTL 1	Remembering
8.	What you mean by poikilothermous?		CO4	BTL 2	Understanding
9.	What is the pharmacokinetic model?		CO4	BTL 2	Understanding
10.	What is anatomy thermoregulation?		CO4	BTL 1	Remembering
11.	If the following statement is true justify, “at any time an amount of thermal energy is stored approximately proportional to temperature”.		CO4	BTL 2	Understanding
12.	Draw the information flow diagram of human thermoregulation control system.		CO4	BTL 1	Remembering
13.	Identify the basal metabolic rate of body.		CO4	BTL 1	Remembering
14.	How much muscles are in the male body?		CO4	BTL 1	Remembering
15.	How the heat was transfer in our body?		CO4	BTL 2	Understanding
16.	Point out the function of bimetal strip.		CO4	BTL 2	Understanding
17.	List the two complementary sit of hypothalamus.		CO4	BTL 1	Remembering
18.	What is the heat balance equation for thermoregulation?		CO4	BTL 1	Remembering
19.	Sketch the cylindrical lumped mode body temperature regulation.		CO4	BTL 1	Remembering
20.	What is the convection of heat transfer?		CO4	BTL 1	Remembering
21.	Calculate the heat flow equation Fc from uniform surface area.		CO4	BTL 2	Understanding
22.	State the Stefan-Boltzmann law.		CO4	BTL 1	Remembering
23.	Sketch the basic nonlinearity relation of skin surface.		CO4	BTL 1	Remembering
24.	State the radiating heat transfer rate.		CO4	BTL 1	Remembering
	PART – B				
1.	What are the three region of controlled process of body actuating mechanisms? Explain each mechanism with information flow diagram.	(13)	CO4	BTL 3	Applying
2.	Explain the controlled process and actuator in detail.	(13)	CO4	BTL 3	Applying
3.	Which system is working as thermal insulator of body? Explain and how is differ from cold weather.	(13)	CO4	BTL 3	Applying
4.	Describe the function of house thermoregulation, and draw	(13)	CO4	BTL 3	Applying

	the information flow diagram.				
5.	Describe the process of heat was transfered into linear surface skin.	(13)	CO4	BTL 3	Applying
6.	Discriminate the function of control and comparator of hypothalamus and explain with the suitable example.	(13)	CO4	BTL 4	Analysing
7.	a). What is lumping process? b). How the heat was distributed homogeneously in body and explain with one-dimensional homogeneous heat conduction?	(3) (10)	CO4	BTL 4	Analysing
8.	Illustrate how the temperature was regulated in lumped mode in body and draw the diagram of slob mod and cylindrical mode.	(13)	CO4	BTL 3	Applying
9.	Summarize the process of skin surface heat that are lost by convection, evaporation and radiation, using heat-transfer equation.	(13)	CO4	BTL 3	Applying
10.	State the Stefan-Boltzmann law and explain in detail.	(13)	CO4	BTL 3	Applying
11.	Derive taylors series in terms of first derivative.	(13)	CO4	BTL 4	Analysing
12.	Derive the heat balanced equation in terms of body control process from first law of thermodynamics.	(13)	CO4	BTL 4	Analysing
13.	Interpret the steady state response of thermoreceptor characteristics of control function.	(13)	CO4	BTL 3	Applying
14.	Write a short note on following mathematical model of control function a). Thermoreceptor characteristics dynamic response, b). Heat flux control of evaporation rate.	 (7) (6)	CO4	BTL 4	Analysing
15.	Write a short note on Pharmacokinetic modelling parameters in detail.	(13)	CO4	BTL 3	Applying
16.	Define half-life, and describe about half-life in Pharmacokinetic modelling.	(13)	CO4	BTL 3	Applying
17.	Explain the controlled process body with necessary block diagram.	(13)	CO4	BTL 3	Applying
	PART – C				
1.	Express the following function of feedback transducers temperature measurement a). Cutaneous thermoreceptors. b). Hypothalamic thermoreceptors.	 (8) (7)	CO4	BTL 3	Applying
2.	What is the function of Hypothalamic thermoreceptors and explain with information flow diagram?	(15)	CO4	BTL 3	Applying
3.	Explain the following function of anatomy thermoregulation, a). Controlled process and actuator in body, b). Feedback transducer in temperature measurement, c). Controller and comparator of hypothalamus.	 (5) (5) (5)	CO4	BTL 3	Applying
4.	Analyze the following example of heat transfer function in linear and nonlinear surface a). Mode of heat transfer,	 (5)	CO4	BTL 3	Applying

	b). Taylors series expansion, c). Nonlinearity and nonlinearity.	(5) (5)			
5.	Outline the following mode of heat transfer in linear and nonlinear surface, a). Convection, b). Evaporation, c). Radiation.	 (5) (5) (5)	CO4	BTL 3	Applying

	UNIT – V: SIMULATION OF PHYSIOLOGICALSYSTEMS			
	Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.			
	PART – A			
Sl.No.	**Questions**	**CO**	**BT Level**	**Competence**
1.	How simulation is used in physiological system.	CO5	BTL 2	Understanding
2.	Define drug delivery system and classify.	CO5	BTL 1	Remembering
3.	What is the need of physiological Modelling?	CO5	BTL 1	Remembering
4.	Write the two attribute of physiological linear time invariant systems.	CO5	BTL 1	Remembering
5.	How to express the mathematically LTI physiological systems?	CO5	BTL 2	Understanding
6.	Express equation of the physically realizable or non-anticipatory physiological system.	CO5	BTL 2	Understanding
7.	What are state models of linear time invariant systems?	CO5	BTL 2	Understanding
8.	Interpret the advantages of sinusoidal biological testing signal.	CO5	BTL 1	Remembering
9.	Outline the function of receptors.	CO5	BTL 2	Understanding
10.	Write the limp dynamic of neuromuscular motion model.	CO5	BTL 1	Remembering
11.	Describe the equation of muscle mod neuromuscular motion model.	CO5	BTL 2	Understanding
12.	What are the components of the muscle spindle?	CO5	BTL 1	Remembering
13.	Draw the block diagram of neuromuscular reflex model system.	CO5	BTL 1	Remembering
14.	What is the equation for the linear and time-invariant system?	CO5	BTL 2	Understanding
15.	Distinguish between transfer function and loop transfer function.	CO5	BTL 2	Understanding
16.	Sketch the loop transfer function of biological receptors.	CO5	BTL 1	Remembering
17.	What organs are in renal system?	CO5	BTL 1	Remembering
18.	Outline the structure and function of the renal system.	CO5	BTL 1	Remembering
19.	Write the hixson crowell equation?	CO5	BTL 2	Understanding
20.	What is korsmeyer Peppas model?	CO5	BTL 1	Remembering
21.	Identify some new drug delivery methods.	CO5	BTL 2	Understanding
22.	Differentiates between fickian and non fickian diffusion.	CO5	BTL 2	Understanding
23.	Point out the noyes whitney equation?	CO5	BTL 2	Understanding
24.	Draw the graphical representation of transfer function of biological systems.	CO5	BTL 1	Remembering

	PART – B				
1.	Explain the types of receptors in biology with suitable block diagram.	(13)	CO5	BTL 3	Applying
2.	Describe the characteristics of biological receptors and draw the characteristics equation simulink diagram.	(13)	CO5	BTL 3	Applying
3.	a). Define transfer function models of receptors. b). Explain nonlinear transfer mode of receptors.	(5) (8)	CO5	BTL 3	Applying
4.	Describe the mathematical model of neuromuscular model, and explain each characteristics of the model.	(13)	CO5	BTL 3	Applying
5.	Analyze the following model of neuromuscular system. a). Limb dynamics, b). Muscle model.	 (7) (6)	CO5	BTL 4	Analyzing
6.	Interpret the following component of neuromuscular model, a). Plate equation, b). Muscle spindle model.	 (6) (7)	CO5	BTL 3	Applying
7.	Describe the block diagram of neuromuscular reflex mode, and explain each of blocks.	(13)	CO5	BTL 3	Applying
8.	Describe the role of computer simulation software like (MATLAB/Simulink) in modeling and simulating physiological systems.	(13)	CO5	BTL 3	Applying
9.	Formulate the transfer function of biological receptors and draw the Simulink diagram of transfer function biological receptors.	(13)	CO5	BTL 4	Analysing
10.	Discriminate the perceived intensity and biological receptor with necessary diagrams.	(13)	CO5	BTL 3	Applying
11.	a). Write the noyes whitney equation? b). How the particle size are reduced the total effective surface area of drug particle are increased, explain with suitable equation?	(4) (9)	CO5	BTL 3	Applying
12.	Explain the following polymer-based Nano particulate drug-delivery systems, a). Hydrogel-based Nano particulate drug-delivery systems, b). Silicone Nano pore-membrane-based drug-delivery system.	 (7) (6)	CO5	BTL 3	Applying
13.	Write the noyes whitney equation of drug delivery model and explain with each parameters.	(13)	CO5	BTL 3	Applying
14.	Describe the drug delivery physiological system model.	(13)	CO5	BTL 3	Applying
15.	Outline the renal physiological system model with each block	(13)	CO5	BTL 4	Analysing
16.	Describe the neuromuscular physiological system model.	(13)	CO5	BTL 4	Analysing
17.	Express the transfer function biological receptors, and sketch the symmetric diagram of the transfer function biological receptors.	(13)	CO5	BTL 3	Applying
	PART - C				
1.	Illustrate the function of drug delivery model and explain each model function.	(15)	CO5	BTL 3	Applying

2.	Explain the operation of biological receptor of neuromuscular model.	(15)	CO5	BTL 3	Applying
3.	Outline the following simulation of physiological receptor systems functions, a). Transfer function models of receptors, b). Characteristics receptor.	(8) (7)	CO5	BTL 4	Analysing
4.	Write short notes on following system model, a). Neuromuscular system model, b). Renal System model.	(8) (7)	CO5	BTL 3	Applying
5.	Analyse the drug delivery physiological system model in detail.	(15)	CO5	BTL 4	Analysing