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

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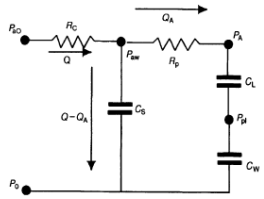
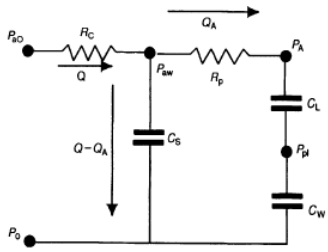
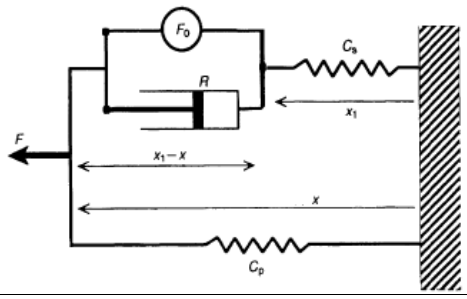
DEPARTMENT OF MEDICAL ELECTRONICS

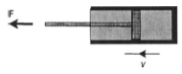
QUESTION BANK

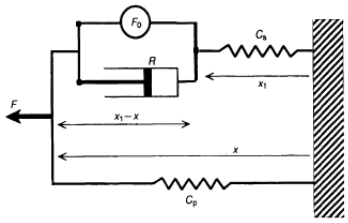
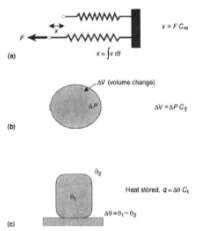
SUBJECT : 1910701 - PHYSIOLOGICAL MODELLING

SEM / YEAR : VII / IV

UNIT – I: INTRODUCTION TO PHYSIOLOGICAL MODELING			
Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.			
PART – A			
S.No.	**Questions**	**BT Level**	**Competence**
1.	What is physiological modeling?	BTL 1	Remembering
2.	Write the need of physiological Modelling?	BTL 2	Understanding
3.	Describe the physiological models in Biopharmaceutics?	BTL 4	Analyzing
4.	What are the steps of modeling process?	BTL 1	Remembering
5.	Label the four physiological processes?	BTL 1	Remembering
6.	Identify the 4 steps of the mathematical modeling process?	BTL 2	Understanding
7.	Illustrate the need for Mathematical Modelling of a physiological system?	BTL 3	Applying
8.	Is there math in human physiology?	BTL 4	Analyzing
9.	How is the math related to the human body?	BTL 2	Understanding
10.	Specify the classification of mathematical model of physiological systems.	BTL 3	Applying
11.	Explain the major function of physiological system?	BTL 4	Analyzing
12.	Examine the terms in physiological mode millieu interieur.	BTL 4	Analyzing
13.	Draw the open-loop control system and a closed-loop system.	BTL 3	Applying
14.	Express the muscle stretch reflex negative feedback system	BTL 2	Understanding
15.	Discriminate the between engineering and physiological control systems.	BTL 4	Analyzing
16.	Outline the time invariant and time varying system?	BTL 2	Understanding
17.	What is the physiological process of homeostasis?		
18.	State the cell homeostasis in biology.	BTL 1	Remembering
19.	Maintain any two the relationship between insulin resistance and hyperinsulinemia?	BTL 3	Applying
20.	List the three interdependent components of homeostatic control mechanisms	BTL 1	Remembering
21.	Name the cells transport materials.	BTL 1	Remembering
22.	How do cells interact with their environment	BTL 4	Analyzing

23.	What are the basic elements of the classical cell?		BTL 3	Applying
24.	Write the different between distributed-parameter versus lumped-parameter Models		BTL 2	Understanding
	PART – B			
1.	Brief the Description of the Actors Involved in Energy Homeostasis.	(13)	BTL 4	Analyzing
2.	Explain the instrinsic, extrinsic factors of homeostatic control mechanisms model of physical systems.	(13)	BTL 3	Applying
3.	Why most of the homeostatic processes use negative feedback regulation, explain with shot able diagram.	(13)	BTL 4	Analyzing
4.	Draw the positive feedback mechanism of the blood clotting cascade homeostatic processes and explain each block.	(13)	BTL 1	Remembering
5.	Calculate the number of moles of sodium hydroxide (NaOH) needed to make 2.50 L of 0.100 M NaOH.	(13)	BTL 3	Applying
6.	For given circuit as linear models of physiological systems derive the mathematical model. 	(13)	BTL 4	Analyzing
7.	Explain the distributed-parameter model of physiological systems. Given shot able example.	(13)	BTL 3	Applying
8.	Find the mechanical equivalent of the electrical analog of respiratory mechanics shown in Figure 	(13)	BTL 2	Understanding
9.	Explain the following system with diagram, a). time varying systems for physiological modelling. b). block diagram analysis Physiol.	 (7) (6)	BTL 2	Understanding
10.	Write the equation of electrical analog of the muscle mechanics model shown in Figure. 	(13)	BTL 1	Remembering

11.	show the expression of steady-state response linear physiological system and Explain.	(13)	BTL 3	Applying
12.	What is the system function of given transfer function equation? $$Y(s) = \frac{0.5s + 1.25}{s(s+1)(0.25s+1)}$$	(13)	BTL 2	Understanding
13.	Explain time varying systems for physiological modeling, with shot able example.	(13)	BTL 3	Applying
14.	Express the physiology homeostasis modeling physical systems, draw the mathematical representation	(13)	BTL 4	Analyzing
15.	To elaborate the physiology cell biology modeling physical systems, draw the symmetric block diagram.	(13)	BTL 2	Understanding
16.	Write shot note on following , a). Classification of physiological models, b). Mathematical modeling of physiological systems.	 (7) (6)	BTL 1	Remembering
17.	Explain with shoutable equation, a). linear models of physiological systems, b). the Laplace transforms.	 (7) (6)	BTL 1	Remembering
	PART – C			
1.	Figure shows a schematic diagram of the 5-element Windkessel model that has been Used to approximate the hemodynamic properties of the arterial tree. The model consists of a distensible aorta and a lumped representation of the rest of the arterial vasculature. The latter is modeled as a simple parallel combination of peripheral resistance, R_p, and peripheral compliance, C_p . The mechanical parameters pertinent to the aortic portion are: (a) the compliance of the aortic wall, C_{ao}' (b) the viscous resistance of the aortic wall, R_{ao}; and (c) the inertance to flow through the aorta, L_{ao}. Note that resistance to flow in the aorta is considered negligible compared to R_p. Construct the electrical analog of this model and derive the transfer function and equivalent state-space model relating aortic pressure, P_{ao}' to aortic flow, Q. a).  b).  c). 	(15)	BTL 4	Analyzing

2.	what different version of linear muscle mechanics from that displayed in Figure a) is shown in Figure P2.2. Here, the elastic element, Cp, is placed in parallel to the viscous damping element R and the contractile element, and the entire parallel combination is placed in series with the elastic element, Cs, and the lumped representation of the muscle mass, m. Derive an expression for the transfer function relating the extension of the muscle, x, to an appliedforce, F. Convert this transfer function description into the equivalent statespace model. a)  b) 	(15)	BTL 2	Understanding
3.	Write detail in block diagram analysis Physiology? Give shot able example and explain.	(15)	BTL 1	Remembering
4.	Describe characteristics of physiological models, give shot able example for each characteristic of mathematical expression	(15)	BTL 4	Analyzing
5.	Explain the time invariant systems for physiological modeling with shot able example.	(15)	BTL 3	Applying

UNIT – II: MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM			
Dynamic systems and their control, modeling 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			
S.No.	**Questions**	**BT Level**	**Competence**
1.	What do you mean by dynamic system?	BTL 1	Remembering
2.	Categorize the different type of dynamic systems?	BTL 3	Applying
3.	Which of the following is a dynamic system? a). y(t) = x(2t), b). y(t) = x(t) - x(t-1)	BTL 3	Applying
4.	Write the characteristics of system behaviour in dynamic system?	BTL 2	Understanding
5.	Draw the structural representation of dynamic system?	BTL 2	Understanding
6.	Find the feedback control system configuration.	BTL 1	Remembering
7.	What you mean active control configuration system?	BTL 4	Analyzing
8.	List the different between active and passive feedback control systems.	BTL 1	Remembering
9.	Analyze characters of man-machine systems.	BTL 4	Analyzing
10.	Infer the information flow diagram of mathematical model of systems.	BTL 2	Understanding

11.	How the causal flow information about biochemical fuel (oxygen) in gasoline?	BTL 3	Applying
12.	What is the voltage level of electrophysiological signals?	BTL 1	Remembering
13.	Why we need amplifier in electrophysiological system?	BTL 3	Applying
14.	Illustrate the equation of dynamic system transfer function?	BTL 4	Analyzing
15.	Draw the diagram of active controlled configuration of information flow in blood?	BTL 3	Applying
16.	Write the equivalent comparator action of nonlinearity of pupil control system.	BTL 2	Understanding
17.	Discriminate to write what are the system behavior?	BTL 4	Analyzing
18.	Determine primary object of servomechanism.	BTL 3	Applying
19.	List the function of actuator	BTL 1	Remembering
20.	Which device is used the feed backed measuring device?	BTL 4	Analyzing
21.	What is the open loop gain?	BTL 1	Remembering
22.	Why transfer function (H) of closed loop is -1?	BTL 4	Analyzing
23.	Define in terms feed forward of aperture control.	BTL 1	Remembering
24.	Describe the half cycle delay in terms of pupil control	BTL 2	Understanding

PART – B

1.	Discriminate the following in term of dynamic system, a). Pupil control systems, b). Feedback control systems configuration.	(7) (6)	BTL 3	Applying
2.	Derive the weber Fechner law of retinal block of pupil control system	(13)	BTL 4	Analyzing
3.	Analyze the generic structure of control system.	(13)	BTL 4	Analyzing
4.	What is in stability of closed loop? Explain the instability of closed loop and draw suitable block diagram.	(13)	BTL 1	Remembering
5.	Derive the expression for loop gain “K” of open loop of closed-loop system	(13)	BTL 3	Applying
6.	What you mean by information flow of dynamic system? Describe in terms of men machine using speed control of car.	(13)	BTL 1	Remembering
7.	How the quantitative analysis is to make the mathematical models? Explain with suitable example	(13)	BTL 2	Understanding
8.	Explain Pupil control system? Give suitable block diagram.	(13)	BTL 2	Understanding
9.	In pupil control systems, how the information are flow from brine cell? Explain with suitable dynamic system diagram representation	(13)	BTL 1	Remembering
10.	Distinguish between servomechanism and regulator. Explain with generic structure of control systems	(13)	BTL 4	Analyzing
11.	Demonstrate automatic aperture control analog pupil system.	(13)	BTL 3	Applying
12.	Illustrate function of automatic control of camera aperture. Explain with the system diagram	(13)	BTL 3	Applying
13.	Examine the Instability of Closed loop negative feedback systems of pupil system	(13)	BTL 4	Analyzing
14.	Point out following in terms of open and closed loop dynamic systems, a). Opening of closed loop system,	(6)	BTL 1	Remembering

	b). Instability of closed loop systems.	(7)		
15.	Outline the dynamic response characteristics of the pupil control system, a). Steady state response, b). Dynamic response.	 (6) (7)	BTL 1	Remembering
16.	Express the function of energy definition of dynamic system component.	(13)	BTL 2	Understanding
17.	Describe the structural component of control system.	(13)	BTL 2	Understanding
PART – C				
1.	Estimate the following characteristics of pupil control system, a). Study state response, b). Dynamic response.	 (7) (8)	BTL 4	Analyzing
2.	Write short not on following, a). System, b). Dynamic system, c). Control system.	 (5) (5) (5)	BTL 1	Remembering
3.	How the negative feedback subtracted from input of active and passive dynamic control system? Justify the output of the system and give suitable block diagram representation.	(15)	BTL 4	Analyzing
4.	Summarise the following terms, a). Information versus energy and material flows, b). Amplifier, c). Modeling transfer function.	 (5) (5) (5)	BTL 3	Applying
5.	Explain the following in terms of dynamic system control, a). Retinal block – comparator, b). Retinal block – logarithmic sensitivity, c). Retinal block – adaptation dynamics.	 (5) (5) (5)	BTL 2	Understanding

UNIT – III: NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS			
Nonparametric Modeling -Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modeling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.			
PART – A			
S.No.	**Questions**	**BT Level**	**Competence**
1.	Compare between Volterra and wiener nonlinear model?	BTL 2	Understanding
2.	What is wiener class systems?	BTL 1	Remembering
3.	How is the wiener kemels cannot be obtained, then approximations of Volterra kernels ?	BTL 4	Analyzing
4.	Write the Differents between Volterra model predication and wiener model predication?	BTL 3	Applying
5.	Write the equation of first order Volterra model mean square error?	BTL 3	Applying
6.	What is the structure akin multivariate Hermite polynomials?	BTL 1	Remembering
7.	Which reason wiener MIT not apply practically physiological system?	BTL 4	Analyzing
8.	Draw the block structure wiener nonlinear model.	BTL 2	Understanding

9.	What is the m^{th}-order output residual of cross-correlation wiener kernel ?	BTL 1	Remembering
10.	Express the predication error of wiener kernel?	BTL 3	Applying
11.	Illustrate the advantage and disadvantage of PRS?	BTL 3	Applying
12.	Draw the equation of Nonwhite Gaussian Inputs apparent transfer function?	BTL 3	Applying
13.	What you mean by duffing systems in apparent transfer function?	BTL 1	Remembering
14.	List the efficient of Volterra kernel estimation.	BTL 1	Remembering
15.	What are the limitations cross-correlation techniques?	BTL 2	Understanding
16.	Describe about the optimized input parameter estimation error.	BTL 4	Analyzing
17.	Analysis a nonlinear input-output relation, when the system is static and nonlinear.	BTL 4	Analyzing
18.	What are nonparametric models what is nonparametric learning?	BTL 2	Understanding
19.	Describe the mathematical equation of function of line	BTL 2	Understanding
20.	What is the difference between parametric and nonparametric method?	BTL 2	Understanding
21.	Show the Volterra principle?	BTL 3	Applying
22.	When the system is stationary?	BTL 4	Analyzing
23.	Describe the mathematical equation of function of line.	BTL 2	Understanding
24.	How you describe the system is dynamic nonlinearity?	BTL 4	Analyzing

PART – B

1.	Distinguish the relation between Volterra and wiener nonlinear model interims of time and frequency and give suitable equation.	(13)	BTL 2	Understanding
2.	Categorize the functionality of following nonlinear model of physical systems, a). Wiener class systems, b). Volterra model predication.	 (7) (6)	BTL 3	Applying
3.	How is the static nonlinear system having no formal equivalent Wiener model, its kernels are not square integrable and do not satisfy the condition? Explain and write equation.	(13)	BTL 4	Analyzing
4.	illustrate the following nonlinear model system, a). Relation between volterra and wiener models. b). Wiener Approach to Kernel Estimation.	 (7) (6)	BTL 3	Applying
5.	Explain the Cross-Correlation Technique for Wiener Kernel Estimation.	(13)	BTL 2	Understanding
6.	To illustrate the application of the cross-correlation technique on a real system.	(13)	BTL 3	Applying
7.	What is the relation between CSRS and Volterra kernel? Explain with an analytical example.	(13)	BTL 1	Remembering
8.	Brief about following measurement of nonlinear systems, a). Apparent transfer function and coherence measurement, b). What are the remarks of apparent transfer function?	 (7) (6)	BTL 4	Analyzing
9.	Write shot nots on the following, a). Model order detection, b). Effective Volterra kernel estimation.	 (7) (6)	BTL 1	Remembering

10.	Analysis about high-order volterra modeling with equivalent networks of nonparametric modelling.	(13)	BTL 4	Analyzing
11.	What is source estimation errors? Explain with Estimation Errors Associated with the Cross-Correlation Technique of nonparametric modeling.	(13)	BTL 1	Remembering
12.	How the estimation error is associated direct inversion and Iterative Cost-Minimization method? Explain with shoutable equation.	(13)	BTL 3	Applying
13.	When the system is static and nonlinear, write the nonlinear input and output relation, explain with basic parametric estimation process.	(13)	BTL 4	Analyzing
14.	Write the mathematical relation between the Riccati equation and the Volterra functional expansion of nonlinear differential equations using volter kernel?	(13)	BTL 1	Remembering
15.	Summaries the application of volterra kernels of nonlinear differential equations and give the analytical example of Riccati Equation volterra kernels, explain.	(13)	BTL 2	Understanding
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)	BTL 1	Remembering
17.	Describe the following nonlinear models, a). Volterra Models, b). Wiener Models	 (6) (7)	BTL 4	Analyzing
	PART – C			
1.	Compute the following estimation in terms of nonlinear systems , a). Estimation Variance, b). Noise Effects, c). Scaling of Kernel Estimates.	 (5) (5) (5)	BTL 3	Applying
2.	Discriminate about 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)	BTL 4	Analyzing
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)	BTL 2	Understanding
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)	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)	BTL 1	Remembering

UNIT – IV: COMPARTMENTENTAL PHYSIOLOGICAL MODE			
Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical Modeling 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			
S.No.	**Questions**	**BT Level**	**Competence**
1.	What is the mathematical model of system?	BTL 1	Remembering
2.	Identify the use of the mathematical model of system.	BTL 2	Understanding
3.	Write the drawback of dynamic systems?	BTL 3	Applying
4.	Express the two approach of modeling comprises	BTL 3	Applying
5.	Describe the transfer characteristics of sensory neural receptors.	BTL 2	Understanding
6.	Relate the control process of physical modelling ?	BTL 4	Analyzing
7.	Define active control system of modeling.	BTL 1	Remembering
8.	What you mean by poikilothermous?	BTL 2	Understanding
9.	Discriminate when the temperature metabolic rate is doubled?	BTL 4	Analyzing
10.	What is anatomy thermoregulation?	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”.	BTL 4	Analyzing
12.	Draw the information flow diagram human thermoregulation control system?	BTL 3	Applying
13.	Predict the basal metabolic rate of body.	BTL 3	Applying
14.	How much skeletal muscle are surrounded men body wight?	BTL 1	Remembering
15.	How the heat was transfer in our body?	BTL 2	Understanding
16.	Infer the function of bimetal strip?	BTL 4	Analyzing
17.	List the two complementary sit of hypothalamus	BTL 1	Remembering
18.	Analyze the equation of steady flow of heat in thermoregulation of body?	BTL 4	Analyzing
19.	Sketch the cylindrical lumped mode body temperature regulation.	BTL 3	Applying
20.	What is convection of heat transfer?	BTL 1	Remembering
21.	Calculate the heat flow equation Fc from uniform surface area?	BTL 2	Understanding
22.	Outline the Stefan-Boltzmann law?	BTL 4	Analyzing
23.	Sketch the basic nonlinearity relation of skin surface.	BTL 3	Applying

24.	State the radiating heat transfer rate.		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)	BTL 1	Remembering
2.	What is controlled process and actuator? Explain with diagram	(13)	BTL 1	Remembering
3.	Which system is waking as thermal insulator of body? Explain and how is differ from cold weather.	(13)	BTL 4	Analyzing
4.	Describe the function of house thermoregulation, and draw the information flow diagram, explain with each block	(13)	BTL 2	Understanding
5.	How the heat was maintenance in control muscle metabolism and explain with diagram.	(13)	BTL 2	Understanding
6.	Discriminate the function of control and comparator of hypothalamus and explain with suitable example.	(13)	BTL 4	Analyzing
7.	What is lumping process? How the heat was distributed homogeneously in body and explain with one-dimensional homogeneous heat conduction?	(13)	BTL 3	Applying
8.	Illustrate how the temperature was regulate lumped mode in body and draw the diagram of slob mod and cylindrical mode	(13)	BTL 3	Applying
9.	Summarize the skin surface heat are lost by convection, evaporation and radiation, using heat-transfer equation.	(13)	BTL 2	Understanding
10.	State the Stefan-Boltzmann law? And explain.	(13)	BTL 1	Remembering
11.	Discusses the heat was transfer in linear surface skin, how to express taylors series in terms of first derivative	(13)	BTL 2	Understanding
12.	Derive the heat balanced equation in terms of body control process from firs law of thermodynamics	(13)	BTL 4	Analyzing
13.	Interpret the steady state response of thermoreceptor characteristics of control function.	(13)	BTL 3	Applying
14.	Categorize following mathematical model of control function a). Thermoreceptor characteristics dynamic response, b). Heat flux control of evaporation rate.	(7) (6)	BTL 4	Analyzing
15.	Write shot note on Pharmacokinetic modeling parameters.	(13)	BTL 2	Understanding
16.	Define half-life, and discus about half-life in Pharmacokinetic modeling	(13)	BTL 1	Remembering
17.	Sketch the block diagram of controlled process body and explain each block.	(13)	BTL 3	Applying
PART – C				

1.	Express the following function of feedback transducers temperature measurement a). Cutaneous thermoreceptors. b). Hypothalamic thermoreceptors.	 (8) (7)	BTL 1	Remembering
2.	What is the function of Hypothalamic thermoreceptors and explain with information flow diagram?	(15)	BTL 2	Understanding
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)	BTL 3	Applying
4.	Analyze the following example of heat transfer function in linear and nonlinear surface a). More mode of heat transfer, b). Taylors series expansion, c). Nonlinearity and nonlinearity.	 (5) (5) (5)	BTL 4	Analyzing
5.	Outline the following mode of heat transfer in linear and nonlinear surface, a). Conversion, b). Evaporation, c). Radiation.	 (5) (5) (5)	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

S.No.	**Questions**	**BT Level**	**Competence**
1.	What is the difference between compartmental and physiologic models in pharmacokinetics?	BTL 1	Remembering
2.	Name the different types of pharmacokinetic models?	BTL 1	Remembering
3.	What is the need of physiological Modelling?	BTL 1	Remembering
4.	Write the two attribute of physiological linear time invariant systems?	BTL 4	Analyzing
5.	How to express the mathematically LTI physiological systems?	BTL 4	Analyzing
6.	Express equation of the physically realizable or non-anticipatory physiological system?	BTL 4	Analyzing
7.	Discriminate the transfer function of linear, time-invariant, constant-parameter of two polynomials physiological system.	BTL 2	Understanding

8.	Interpret the advantages of sinusoidal biological testing signal.		BTL 3	Applying
9.	Describe the function of receptors?		BTL 2	Understanding
10.	Analyze the limp dynamic of neuromuscular motion model.		BTL 4	Analyzing
11.	Describe the equation of muscle mod neuromuscular motion model.		BTL 2	Understanding
12.	Sketch electrical circuit of the component of muscle spindle mode of neuromuscular model		BTL 3	Applying
13.	Draw the block diagram of neuromuscular reflex model system.		BTL 3	Applying
14.	Write the transfer function of receptors?		BTL 3	Applying
15.	Distinguish between transfer function and loop transfer function.		BTL 2	Understanding
16.	Manipulate the loop transfer function of biological receptors.		BTL 3	Applying
17.	What organs are in renal system?		BTL 1	Remembering
18.	Outline the structure and function of the renal system?		BTL 4	Analyzing
19.	Write the hixson crowell equation?		BTL 2	Understanding
20.	What is korsmeyer Peppas model?		BTL 1	Remembering
21.	Identify some new drug delivery methods?		BTL 2	Understanding
22.	Differentiates between fickian and non fickian diffusion?		BTL 2	Understanding
23.	Point out the noyes whitney equation?		BTL 4	Analyzing
24.	Draw the graphical representation of transfer function of biological systems.		BTL 1	Remembering
	PART – B			
1.	What are the types of receptors in biology? Explain with suitable block diagram.	(13)	BTL 1	Remembering
2.	Write characteristics of biological receptors? And draw the characteristics equation Simulink diagram.	(13)	BTL 3	Applying
3.	Define transfer function models of receptors? Explain nonlinear transfer mode of receptors.	(13)	BTL 1	Remembering
4.	Describe the mathematical model of neuromuscular model, and explain each characteristics of the model.	(13)	BTL 2	Understanding
5.	Analyze the following model of neuromuscular system. a). Limb dynamics, b). Muscle model.	 (7) (6)	BTL 4	Analyzing
6.	Interpret the following component of neuromuscular model, a). Plate equation, b). Muscle spindle model.	 (6) (7)	BTL 3	Applying
7.	Draw the block diagram of neuromuscular reflex mode, and explain each of block, write the equation of the block?	(13)	BTL 1	Remembering

8.	Summarize the Simulink implementation of neuromuscular reflex motion, and explain.	(13)	BTL 2	Understanding
9.	Formulate the transfer function of biological receptors and draw the Simulink diagram of transfer function biological receptors.	(13)	BTL 4	Analyzing
10.	Compare the following perceived intensity and biological receptor.	(13)	BTL 2	Understanding
11.	Write the noyes whitney equation? How the particle size are reduced the total effective surface area of drug particle are increased, explain with suitable equation?	(13)	BTL 1	Remembering
12.	Explain the following polymer-based nanoparticulate drug-delivery systems, a). Hydrogel-based nanoparticulate drug-delivery systems, b). Silicone nanopore-membrane-based drug-delivery system.	(7) (6)	BTL 3	Applying
13.	Show the noyes whitney equation of drug delivery model and explain with each parameters.	(13)	BTL 3	Applying
14.	Draw the drug delivery physiological system model using Open CV / Mat Lab, explain each block	(13)	BTL 1	Remembering
15.	Outline the renal physiological system model using Open CV / Mat Lab, explain each block	(13)	BTL 4	Analyzing
16.	Infer the neuromuscular physiological system model using Open CV / Mat Lab, explain each block	(13)	BTL 4	Analyzing
17.	Express the transfer function biological receptors, and sketch the symmetric diagram of the transfer function biological receptors using Open CV / Mat Lab	(13)	BTL 2	Understanding
PART - C				
1.	Illustrate the function of drug delivery model using open CV / MAT lab and explain each model function.	(15)	BTL 3	Applying
2.	Explain the operation of biological receptor of neuromuscular model using open CV / MAT lab Simulation models.	(15)	BTL 2	Understanding
3.	Outline the following simulation of physiological receptor systems functions, a). Transfer function models of receptors, b). Characteristics receptor.	(8) (7)	BTL 4	Analyzing
4.	Write shot notes on following systems model, a). Neuromuscular systems model, b). Renal System model.	(8) (7)	BTL 3	Applying
5.	Analyze the drug delivery physiological system model using Open CV / Mat Lab and explain.	(15)	BTL 4	Analyzing