U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

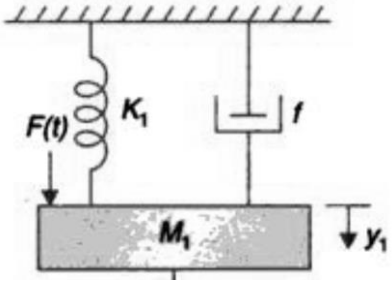
Autonomous Institute Affiliated to VTU

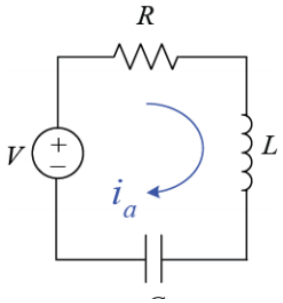
July 2023 Semester End Main Examinations

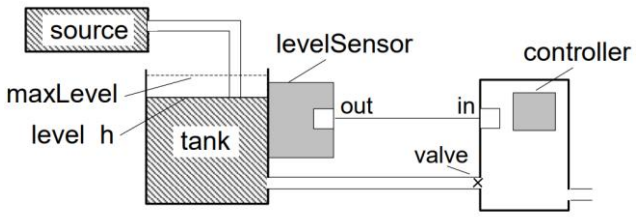
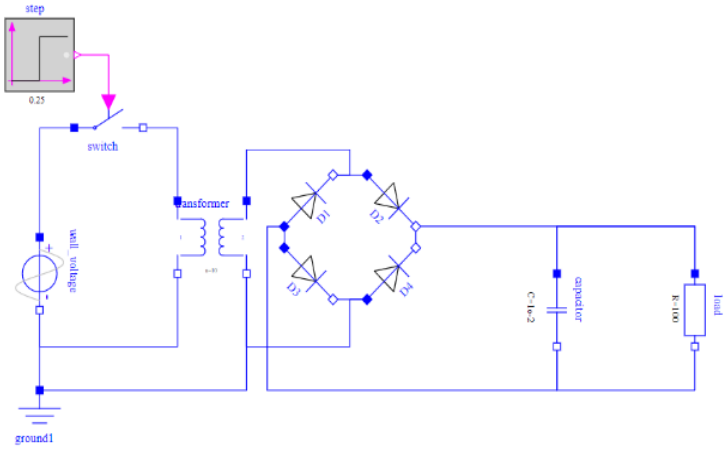
Programme: B.E. **Semester: VI**
Branch: Institutional Elective **Duration: 3 hrs.**
Course Code: 19EI6OE1MD **Max Marks: 100**
Course: Multidomain System Modelling **Date: 07.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	What are dynamic systems? Differentiate classical modeling from data-driven Modeling with an example for each	*CO2*	*PO2*	**08**
	b)	List the purpose of modeling and simulation of a given system. Explain how the simulation models play a role in system analysis?	*CO2*	*PO2*	**06**
	c)	Population dynamics of predator-prey is as follows. (i) Prey can find food, but gets killed on meeting predator (ii) Prey, if left alone, grows at a rate proportional to x1, x1 being the number of Prey (iii) Predator, on meeting prey, kills it at the rate proportional to x1x2, x2 being the number of predators. Develop an approach using numerical method to solve differential equations.	*CO1*	*PO1*	**06**
		UNIT-II			
2	a)	 Fig .2.a Consider a mechanical system as shown in Fig.2.a consisting of Mass M1, Spring K1 and damper f, respectively. Assume F(t)= 50 u(t) N, M1=2 kg, K1= 3 N/m, f=1 N-s/m , y1(0)=0 and the displacement is y1(t). Write the differential equation for the above system and obtain the response of the system.	*CO2*	*PO2*	**10**

		b)	The following equation represents NewtonCooling $mc_p\dot{T} = hA(T_\infty - T)$. Explain the behavioral modelling of the above example using equation method of modelling using open modelica	*CO2*	*PO2*	**10**
			OR			
	3	a)	Represent a bouncing ball model by plotting its trajectory over time by choosing appropriate model parameters, and discus about numerical imprecisions. Justify that it is a "state event".	*CO3*	*PO3*	**10**
		b)	Why do we need numerical solutions? Name any two numerical approximations Methods used in modelling.	*CO2*	*PO2*	**10**
			UNIT - III			
	4	a)	What are '*parameters*' and '*constants*' used in open modelica programming language? Explain with an example.	*CO3*	*PO2*	**06**
		b)	How do you identify a 'state variable' in a dynamic system? Consider a first order mechanical system to identify a state variable.	*CO3*	*PO2*	**06**
		c)	Obtain the second order differential equation for the RLC circuit shown in Fig 3a and sketch the step response for the same using simulation.  Fig 3a	*CO3*	*PO3*	**08**
			OR			
	5	a)	Name the three different approaches of modelling a system which is dynamic in nature using OpenModelica. Represent the modelling by block diagram approach of a pendulum using Open-Modelica Library. Justify the selection of each block.	*CO3*	*PO2*	**10**

		b)	A tank Model is shown in the following diagram (Fig 6.a)  Fig 6.a Write the necessary equations and Model the level control operation for the tank system using open Modelica, which uses a level sensor and a controller to control the valve position.	*CO3*	*PO2*	**10**
			UNIT - IV			
	6	a)	Differentiate Acausal connectors from block connectors. Explain how to create the following components in open-modelica. (i)Resistor (ii)capacitor (iii)Voltage Source and (iv)Ground	*CO3*	*PO2*	**10**
		b)	Describe the underlying equations of "A second order rotational system" Each inertia J, has a rotational position, φ, and a rotational speed, ω , where $\omega = \frac{d\varphi}{dt}$; C and D are constants. For each inertia, the balance of angular momentum for the inertia can be expressed as 1. Equation for Inertia…. $J\frac{d\omega}{dt} = \sum_i \tau_i$ 2. Equation for Spring … $\tau = C\Delta\varphi$ 3. Equation for damper $\tau = D\Delta\frac{d\varphi}{dt}$ Represent the block diagram and sketch the response of the system for different values of input Torque (tow1) by creating a simulation model	*CO3*	*PO3*	**10**
			UNIT - V			
	7	a)	 Fig 7a	*CO3*	*PO3*	**10**

			The Fig 7a represent DC power supply consisting of subsystems. Identify the each sub-system and the components in the circuit Create the circuit diagram for DC power supply with all the components and their connection.			
		b)	What do you mean by multibody library in open modelica. Explain how to develop subsystem model for Pendulum Model using multibody library of open modelica	*CO3*	*PO3*	**10**

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